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The Magazine of New Energy Technology

Cold Fusion • New Energy • Renewable Energy

Volume 7 • Issue 40 • 2001

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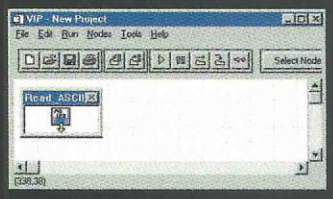

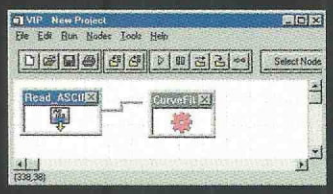

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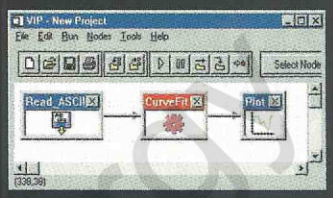

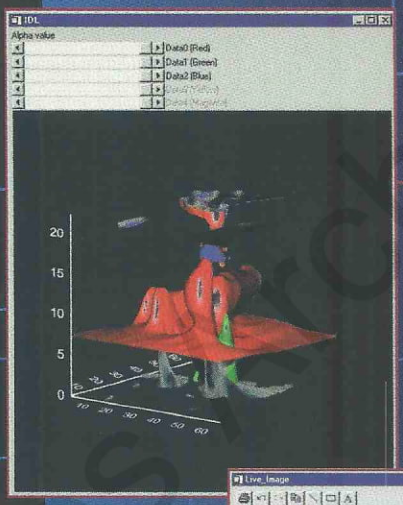

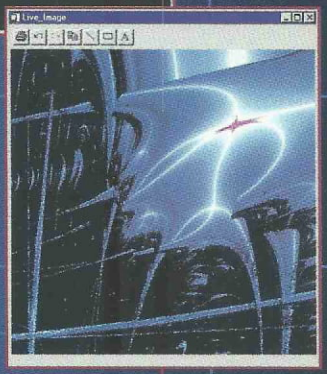

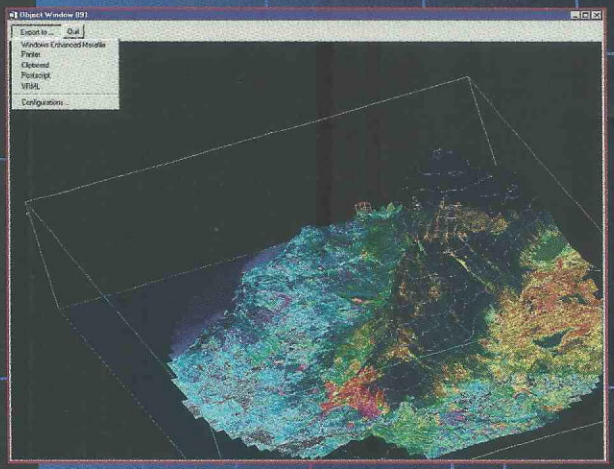

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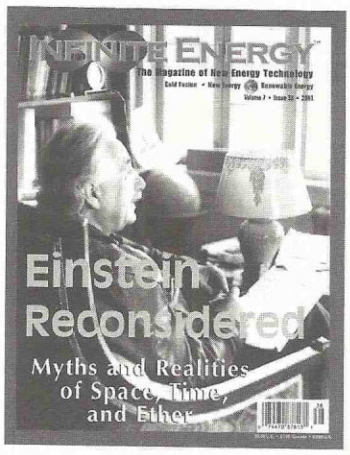

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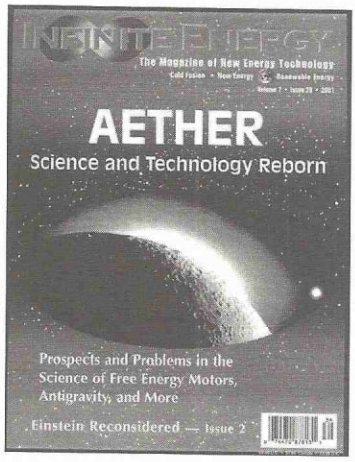

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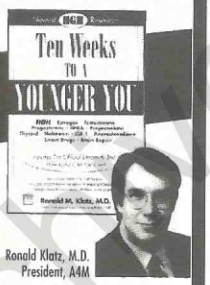

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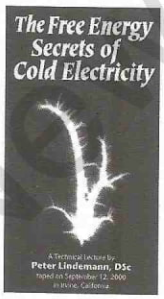

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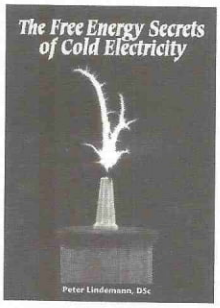

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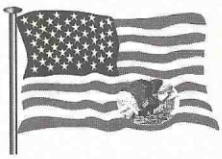

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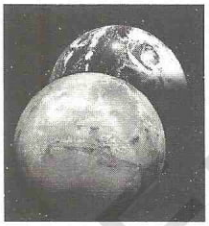

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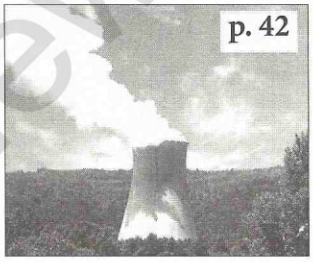

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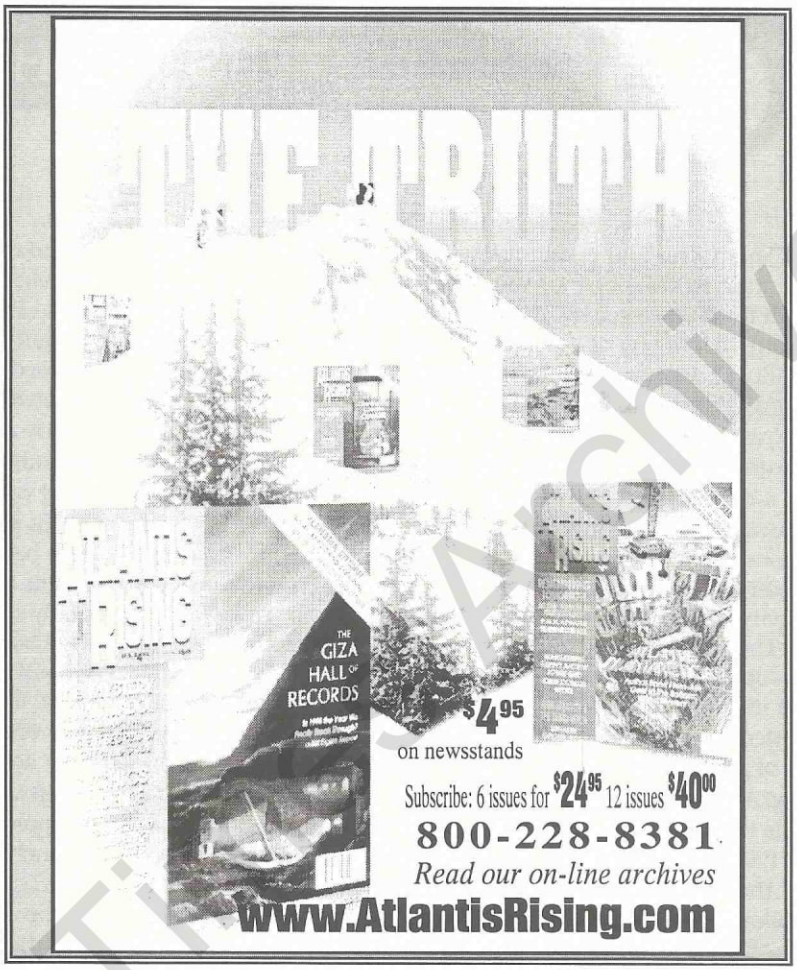

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LETTERS TO THE EDITOR

Einstein Issue Praise

Thanks for and congratulations on the interesting collection in your first Einstein issue (No. 38).

It illustrates a general point that needs making over and over again, that the success of a set of equations doesn't establish the reality of any physical model apparently implied by those equations. That Newton's equations work doesn't mean the world consists of incompressible little particles banging into one another; the success of relativity equations doesn't mean we live in a curved four-dimensional manifold; the "collapse of wave functions" doesn't mean it requires an observer to tell electron-positron pairs how to behave. And so on and on. I first saw this point really hammered home in Herbert Dingle's critique of relativity, *Science at the Crossroads* (1972).

That same point applies also, of course, to all theories offered as superior to existing ones. No matter how appealing a physical model may be, the crucial test is whether its equations are better—more accurate, or covering a wider range of parameters or of phenomena—than the currently used (or "accepted") theory. Any candidate to replace relativity will succeed only if it is able to calculate better and more than relativity equations can.

I'm very pleased to have learned, from John Chappell's piece, of the existence of the interesting organization the Natural Philosophy Alliance. Two peripheral points about his article: 1) Associating anti-relativity with anti-Semitism may be due in part to the fact that many things were attacked in Germany because they were said to have been inspired by Jews. Philipp Lenard published a four-volume work, *Deutsche Physik* (*German Physics*), that sought to remove from physics all "semitic ideas," including relativity. 2) That charges of anti-Semitism figured in the dismissal of physics faculty in the 1920s runs counter to the conventional wisdom that Jews were still being discriminated against, for faculty positions and for admission as students at major U.S. universities, into the 1930s.

Henry H. Bauer
Blacksburg, Virginia
Editor-in-Chief, *Journal of Scientific Exploration*;
Dean Emeritus of Arts & Sciences,
Professor Emeritus of Chemistry & Science Studies
Virginia Polytechnic Institute & State University

The Ether Returns

Einstein's special theory of relativity specifically requires that the one-way velocity of light be a constant. If that turns out not to be so, special relativity falls. The Michelson-Morley experiment, however, demonstrated only that the two-way, over-and-back, average velocity of light was constant. It did not necessarily prove that the one-way velocity of light in any direction was also constant. Consequently, special relativity is founded on a tentative extrapolation that goes far beyond the experimental results of the Michelson-Morley experiment.

Although no one has succeeded in accurately measuring the one-way velocity of light, in 1987 Ernest Silvertooth published the results of an experiment that clearly showed that the wavelength of light varies with the direction of light propagation.[1] His finding provided evidence that the one-way velocity of light also varies with direction. While the Sagnac experiment showed that special relativity does not apply for rotating frames of reference, Silvertooth's experiment indicated that special relativity also does not apply for straight-line motion. Silvertooth assembled a special kind of laser interferometer apparatus to carry out his wavelength measurements.

His apparatus included a complex array of adjustable mirrors and beam splitters that caused two oppositely directed laser beams to interfere and produce a standing wave pattern of regularly spaced bright and dark bands or fringes. He was then able to determine the spacing of these fringes, using a specially built television camera tube with a transparent light-sensing surface. Since the effective thickness of his detector's light-sensing surface was less than 10% of the laser light wavelength, he could very accurately determine the positions of consecutive bright fringes. He found that the fringes achieved their closest spacing of approximately one-fourth of a millimeter (one-hundredth of an inch) when the opposed laser beams were pointing along a direction aligned with the constellation of Leo. When the path of the opposed laser beams was rotated away from that heading, the fringes spread apart to greater distances. He concluded that this unique direction, in which the fringe pattern attained a minimum spacing, marked the direction of the Earth's motion through the ether.

By measuring the minimum fringe spacing, Silvertooth determined that the Earth moves through the ether toward Leo at a speed of about 378 (±19) kilometers per second. Several years later he built a substantially improved version of his earlier apparatus and obtained a similar result.[2] By comparison, astronomers have found that the solar system is moving toward the southern part of Leo at a speed of about 365 (±18) kilometers per second relative to the surrounding 3° Kelvin cosmic microwave background radiation field.[3] This matches Silvertooth's result within the accuracy of the respective measurements, implying that the microwave background radiation is stationary with respect to the local ether rest frame.

Thomas Valone
Integrity Research Institute
Washington, DC

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1. Silvertooth, E.W. 1987. "Experimental Detection of the Ether," *Speculations in Science and Technology*, 10: 3-7; 1989. "Motion Through the Ether," *Electronics and Wireless World*, May: 437-438.
2. Silvertooth, E.W. and Whitney, C.K. 1992. "A New Michelson-Morley Experiment," *Physics Essays*, 5: 82-89.
3. Smoot, G.F. *et al.* 1991. "Preliminary Results from the COBE Differential Microwave Radiometers: Large Angular Scale Isotropy of the Cosmic Microwave Background," *Astrophysical Journal*, 371: L1-L5.

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Diamonds and Cold Fusion

In the literature I found only three references to diamond being used as a direct pressure medium for cold fusion experiments. Only the one by Silvera and Moshary was an actual experiment, with negative results. I have not read the full transcript of this paper, but the abstract indicates that it was a static experiment with relatively large diamonds, *viz.* those of a diamond anvil. I have often wondered if this experiment could be modified to make a positive result more likely.

In the first place there is no need to use Pd as a D carrier, as diamond surfaces are normally hydrogen terminated (source being atmospheric water) and don't stick unless this hydrogen is removed. The H-terminated surface has a coefficient of friction of 0.01, which is comparable with that of Teflon. This is also the reason that a diamond surface is hydrophobic. Diamond can also be obtained as a very fine powder and recently powder sizes in the 10^{-8} m range were advertised, so a small amount of powder will present a large adsorption surface.

My suggestion is: Replace the H on the diamond surface of a mixed sized diamond powder with D. This could be done with normal established procedures. Place this D terminated diamond powder dry, as a D_2O slurry or in a D_2 atmosphere between two small disks of (CVD) diamond and while applying pressure rotate or vibrate the disks in relation to each other. This grinding action under pressure will *create millions of secondary and higher order microscopic diamond anvils* from the diamond particles in a dynamic manner. Extreme localized pressures will become likely and possibly some fusion of the surface adsorbed D compressed between some particles will take place. As some of the powder is very fine, the D concentration should have localized high values and consequently some chain reactions (microbursts) could also take place. Alternatively, the D-terminated-diamond powder can be placed in a normal diamond anvil and pressure applied in a cyclic vibratory manner, such as for example with a PZT device. This will ensure that there is a continuous relative change of particle location. The adsorbed state of the D will also give an automatic temperature control for a possible D-D reaction, as at a certain temperature below the diamond decomposition temperature the diamond-D desorption point will be reached and the reaction will stop. Any used adsorbed D will immediately be replaced by other D from its surrounding medium, while He disposal will not present a major problem, as all reactions are external on the surface within a liquid or gaseous medium.

The only way to find out, though, if this idea will make a positive cold fusion reaction possible is to do the actual experiment(s).

Otto Hello
Tasmania, Australia

Sources

—Van Siclen, C.De.W. and Jones, S.E. 1986. "Piezonuclear Fusion in Isotopic Hydrogen Molecules," *J. Phys. G: Nucl. Phys.*, 12, 213. Asks the question whether high pressure of the order of 10^6 atm, as obtainable from a diamond anvil, can significantly increase the natural fusion rate of hydrogen isotope atoms. There is a lot of theory, but no real conclusion, because some experimental data is needed.

—Fedorovich, G.V. 1993. "A Possible Way to Nuclear Fusion in Solids," *Fusion Technology*, 24, 288. Theory, fractofusion, res+. Once again, the author proposes his E-cell theory, and an experiment to test it. E-cells are radiation defects in certain low atomic weight element (Li, Be, B) hydrides/deuterides, and fission events, caused by neutron capture, start an E-cell. Within it, extremely high electron densities ($10^{24}/cm^3$) hold and this can act as a Coulomb shield for fusion. Also, crystalline lattice forces can be focussed up to hundreds of eV and reduce internuclear distances to 10^{-9} cm, resulting in a measurable hydrogen fusion rate. An experiment is suggested in which a sample is compressed in a diamond anvil to some Mbar, and a neutron beam aimed at it to stimulate fusion. "The further is the matter of experimental physics."

—Silvera, I.F. and Moshary, E. 1990. "Deuterated Palladium at Temperatures from 4.3 to 400K and Pressures to 105 kbar: Search for Cold Fusion," *Phys. Rev.*, B42, 9143. The authors used their diamond anvil to achieve these pressures. Detectors for neutrons, gamma radiation, and heat were mounted around the press. From the volume compression, a loading of up to 1.34 was inferred. Several days at the various temperatures and pressures evinced no evidence for cold fusion.

Recognition for Whitehead

I would hope that your issues dealing with alternatives to Einsteinian relativity theory would contain some mention of that of Alfred North Whitehead. Some salient features of Whitehead's theory: It rejects the substance-ether while upholding what he called the "ether of events" (which is well in line with the later physical concept of vacuum energy). It avoids paradoxical notions such as time dilation and curved space-time, along with the "twins paradox." It accounts for the predictions of SRT and GRT in a single theory. Most significantly, Whitehead rejected the whole positivistic thrust of twentieth century physics, calling it "a state of complete contentment with an ultimate irrationality." His theory has the distinction that some notable physicists (Eddington, for example) have been interested in it and/or taken some trouble to try to refute it (unsuccessfully, in my view).

Daniel Athearn
Eugene, Oregon

Editor's Reply: Thank you for bringing Alfred North Whitehead's views to our attention. We were unaware of his Einstein criticisms. Bravo to his phrase describing twentieth century physics as "a state of complete contentment with an ultimate irrationality"!—*EFM*

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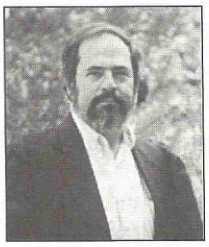


Dear Mr. President: A Remarkable Energy Weapon for Peace Has Been Overlooked

An open letter

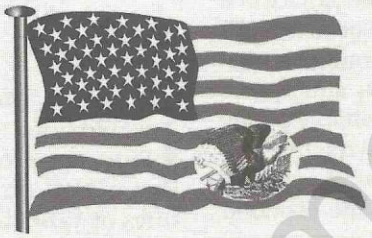
by Eugene F. Mallove, Sc.D.

We bring to your attention a matter of great urgency on the path to a lasting victory over terrorism and to achieve enduring peace. A remarkable discovery made in the United States in the 1980s has been overlooked, because of a serious flaw in our funding for nuclear research. This matter is of the gravest concern, because it is a proven method to extract clean energy from simple, abundant materials. It has yet to be reduced to practical application, but with your help it could be.

I wrote to you earlier this year on this very topic. Indeed, you will find my "Memorandum to the White House" posted on our web site (www.infinite-energy.com). Perhaps amid the intensity of your demanding work, you were unable to respond earlier, or maybe your staff did not believe or recognize the significance of the message. The time has now come for you to render your judgment and assistance during this period of national tribulation.

I write to you again in a humble and hopeful spirit, one month after the appalling terrorist atrocity against our beloved country and the world. It is a new day and I applaud your determination to destroy terrorism wherever it hides or rears its fanatical, ugly head. I personally approve of using measured and crushing military power to administer *infinite justice* on the road to *enduring freedom*. But eliminating terrorism demands using every tool in our possession, as you have so rightly said. Please, Mr. President, heed our call to investigate a remarkable, overlooked weapon for peace and lasting freedom from terrorism. Let me repeat the Executive Summary of my earlier Memorandum, which makes the essential points (see inset).

Executive Summary of 2001 Memorandum to the White House



Beginning in 1989, a class of new energy technologies has been developed that has the potential to provide pollution-free energy of a magnitude far greater than fossil fuel, using forms of hydrogen from water as the fuel in novel catalytic conditions. The technologies challenge the understanding of physics which has been used to justify continued investment in fossil fuels, nuclear power plants, and the so-called "hot fusion" energy research programs. The U.S. government has spent at least $15 billion on hot fusion without achieving the "breakeven" point already achieved by the new energy technologies.

Hydrogen as a fuel in engines and fuel cells has been discussed and demonstrated for several decades. Fuel cells are emerging into the commercial market, using hydrogen-rich chemical compounds. These systems are based on chemical reactions whose energy density (energy per unit of fuel) is very low. There are serious problems in making, storing, and transporting hydrogen. The new energy technologies use hydrogen in a far different way that extracts thousands to millions of times the ordinary chemical combustion energy of hydrogen. Thus, water is fuel!

In 1989, after five years of work and investment of $100,000 of their own money, Professors Stanley Pons and Martin Fleischmann announced the release of nuclear-scale energy from an electrochemical cell using palladium as the cathode metal. In the cell, heavy hydrogen is forced into the palladium until a new class of nuclear reactions occurs, in which energy of great intensity is released without the deadly radiation or radioactive by-products produced by other nuclear energy processes. The Pons-Fleischmann announcement ignited a controversy that is documented in the body and references of this memorandum.

The DOE Energy Research Advisory Board "Cold Fusion Panel" was convened at the direction of President Bush to review the "cold fusion" controversy in its early days. The panel relied heavily on misleading reports from the California Institute of Technology, Harwell (England), and the Massachusetts Institute of Technology. Reports from all three sources were negative, and

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Matters have changed for the better since I wrote that Memorandum to you. Most important, through extensive research at our New Energy Research Laboratory here in Bow, New Hampshire, in collaboration with other scientists across the United States, *we are now prepared to show you and your scientific advisors a conclusive demonstration of an important manifestation of this energy source,* which comes apparently from the heavy hydrogen component in ordinary water. This "sonofusion" process, developed by Silicon Valley scientist Roger Stringham of First Gate Energies, has now been tamed by our group in the form of a small demonstration reactor. It has recently output over eight watts of astonishing cold fusion power for a prolonged period—far longer than required to determine that the "excess power" is of nuclear origin. The possible error in the measured excess power is a tiny 0.2 watt, far smaller than the 8-watt enduring output power. (See additional description on page 36.)

Let that demonstration to you and your advisors be the beginning of a joyful turn-around in a tragedy of errors by official science and the Department of Energy over the past decade. Thereafter, your science and security advisors, as well as newly enlightened members of the Department of Energy, will be able to do the right things, we hope. It is essential that research on and patenting of this new technology no longer be obstructed by bureaucracy and people who were too quick to reject new ideas before careful evaluation.

Perhaps you did not know that there is an incontrovertible fact, well known to scientists working to control thermonuclear fusion energy for peaceful power production: Within only *one* cubic kilometer of water, there exists enough heavy hydrogen isotope, deuterium (heavy hydrogen), such that if it is fused to the element helium at multi-million-degree temperatures, enough energy is released to equal the combustion energy of all the world's *known* oil. This planet has at least one billion cubic kilometers of water; there is no danger of running out of this fuel.

Or, look at it this way: In only one gallon of ordinary water, there is enough heavy hydrogen to produce the energy equivalent of 300 gallons of gasoline. Heavy hydrogen or deuterium, by the way, is simply hydrogen that bears an extra neutron in its nucleus. It is non-radioactive and easy to extract from water very cheaply.

If we had a way to tap this fusion energy safely and cheaply, the world's energy problems would be over; most if not all environmental problems would be well on their way to solution. If we could find a way to release this fusion energy benignly without deadly radiation, and on a small scale, rather than in the stadium-like tokamak thermonuclear fusion reactors—smaller, dysfunctional prototypes of which are being tested at fantastic cost at Princeton, MIT, and elsewhere—a millennial revolution in energy technology would break out. Millions of new high-technology jobs would be created almost overnight—just as at the birth of aviation at the beginning of the last century. The economy would prosper and expand, not collapse! Best of all, it would mean true, blessed energy independence for our nation and the world! It would mean an age in which the recurring cost of energy production would approach zero, since the heavy hydrogen is virtually free. The scope of that revolution would dwarf today's Internet-World Wide Web upheaval. The age of "free information" would have a partner: the age of virtually free energy. It may surprise you to learn that the energy discovery described above has been confirmed by solid published scientific research—some of that by Federal laboratories. Unfortunately, the message of that research was overlooked, like intelligence gathering that is occasionally ignored, to the detriment of our health and safety.

ERAB recommended against any government investment in "cold fusion." This had far-reaching consequences, which seriously impeded but did not stop advances in the field.

After over a decade of work, hundreds of peer-reviewed scientific papers from laboratories around the world confirm the Pons-Fleischmann discovery. It was just the tip of an iceberg of a whole class of nuclear reactions—and other new hydrogen reactions—which occur in metals that are heavily loaded with heavy or normal hydrogen by any of several means. These are often called Low-Energy Nuclear Reactions (LENR), or Chemically-Assisted Nuclear Reactions (CANR). There is also a process, pioneered by BlackLight Power, Inc., that produces catalytically altered hydrogen atoms. What these processes have in common is the release of intense, nuclear-scale energies without damaging radiation or radioactive by-products. Reactors are small scale, requiring simple apparatus and common materials with hydrogen as the fuel. Transmutations of the metal cathode materials are commonly produced. In some cases, where radioactive materials such as uranium and thorium are used in the cells, these are rapidly transmuted into harmless by-products without production of harmful radiation or explosions. In principle, radioactive waste from nuclear reactors can similarly be deactivated without the political and economic costs of burial.

Collectively, these emerging technologies point to a much brighter future for mankind. They do not require resources controlled by any small group of countries. They are concentrated, portable, and democratic. Low cost realization and distribution of devices and systems based on these technologies will require the resources of a market economy and the removal of internal opposition from vested interests in the U.S. government and industries, including arbitrary blocking of "cold fusion" patent applications by the U.S. Patent Office. Originators of these technologies may make fortunes, but in the end mankind will be the beneficiary. Mr. President, you need do only one thing now: Publicly state that you are going to investigate this matter and then do it.

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For just over a decade, the cold fusion and low-energy nuclear reactions revolution has been underway, whether or not the mainstream physics/chemistry establishment and the general science media wish to agree. The barrier that separated conventionally understood chemistry and nuclear physics has come crashing down like the infamous Berlin Wall. The barrier does not exist, at least not within special microphysical domains of palladium, nickel, and other metals in contact with hydrogen. Exotic new physics is at work. The myth of the "End of Science" is again disproved.

Mr. President, the rest may be up to you. You have heard the story. It is true. Every word. Nothing will hold back the cold fusion/new energy revolution from happening in due course, but with the stroke of your pen, a few taps on your computer, or perhaps a few telephone calls, you have it in your power to help accelerate the Cold Fusion/New Energy Age. Just as Secretary of War William Howard Taft in the Roosevelt Administration cut through bureaucratic opposition and forced the Army to call the Wright brothers in 1908 to demonstrate their "flyer" to a crowd of thousands at Ft. Meyer, Virginia—and thereby ended years of doubt about their 1903 accomplishment, launching the Aerospace Age—you can break the opposition of the perpetrators of the "HeavyWatergate" scandal.

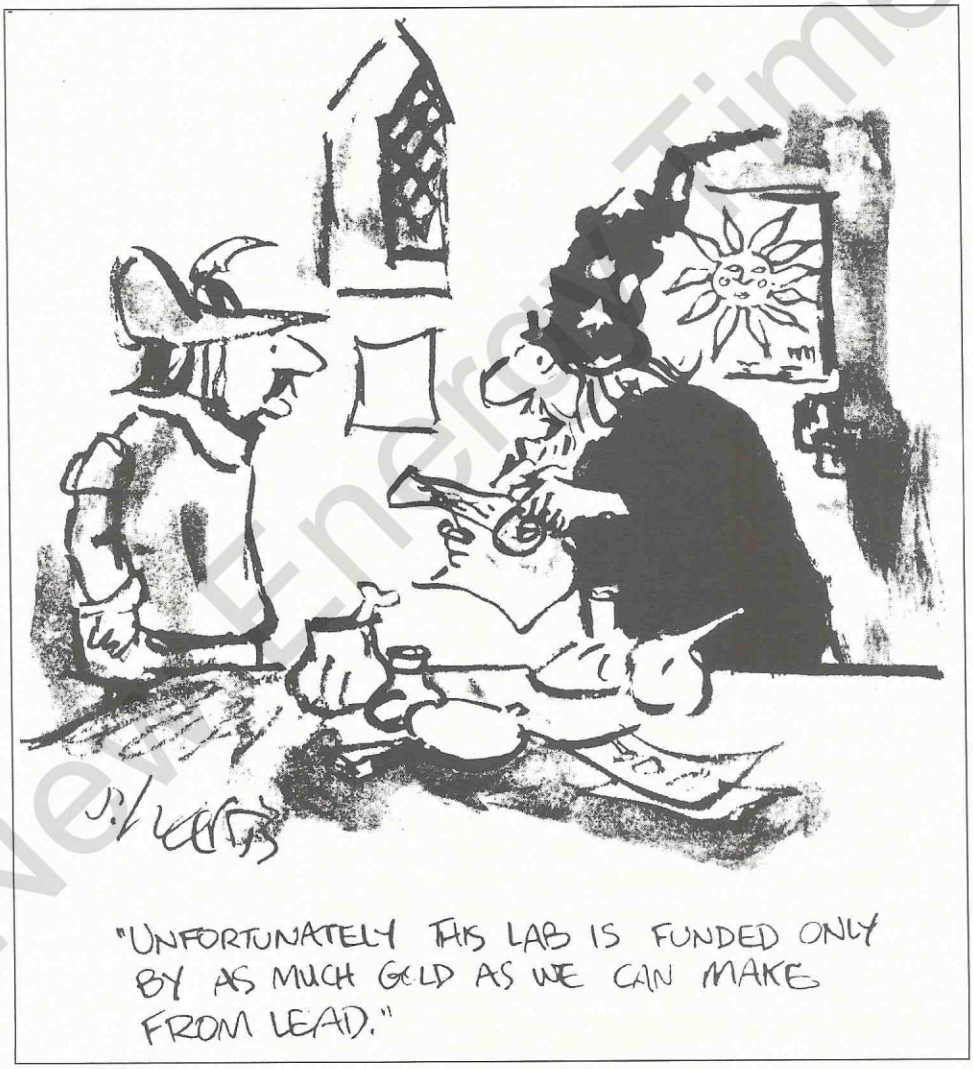
That act of courage and imagination will never be forgotten. Now more than ever, our country and the world needs an act of courage to break through. We pray that you will render this modest assistance. You may think it politically risky to become involved in a controversial matter. But think of this: What is the risk of *not* becoming involved in a controversial matter that happens to be right? And is this not a time that demands high courage?

Let me end with a few remarks made by Sir Arthur C. Clarke in 1999, who recommended in early 2000 that the White House staff request this essay from me:

> "Like everyone else, I was very excited when the so-called 'cold fusion' announcement was made. And then, again like everybody else, I became disappointed and forgot about the whole thing when it seemed to be a mistake, though I was rather puzzled why two world-class scientists could have made such fools of themselves. Well, during the years that followed, slowly, from time to time, there came news of other laboratories repeating the experiment and getting positive results. And there has been a sort of groundswell, all over the whole world, of new information. And during the course of the last five years or so, I've slowly become convinced, from my original skepticism, to 99% certainty that it is for real. The evidence now is really overwhelming. . .
>
> "If these new sources of energy do turn out to be real—and as I say there are several totally different varieties – the question is: What effect will this have on our society? On the future? Well, it's just possible they may be no more than laboratory curiosities, and can't be scaled up to commercial levels. I think that's rather unlikely. Nuclear energy was once a laboratory curiosity. So let's assume that these devices can be developed. The future is then almost unlimited. It could be the end of the fossil fuel age: the end of oil and coal. And the end, incidentally, of many of our worries about global pollution and global warming."

Let me end this letter with a statement of the spirit which I think you will agree led to so many great discoveries and technologies: "Anything that is theoretically possible will be achieved in practice, no matter what the technical difficulties, if it is desired greatly enough." (Arthur C. Clarke, *Profiles of the Future,* 1963). I hope that you will receive this letter in that spirit. Let me thank you, in advance, on behalf of hundreds of researchers in this field who would deeply appreciate your concern and action.

Sincerely,
Dr. Eugene F. Mallove
Editor-in-Chief, *Infinite Energy*



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The Mystery of the Schappeller Device

Henry Stevens*

Karl Schappeller

— Abstract —

Beginning in the 1920s, Austrian inventor Karl Schappeller experimented with and developed a little-known free-energy device with diverse applications. Although interest has been rekindled in modern times in German speaking countries, all official records of this device ended with the end of the Second World War. The device remains little-known in the English speaking world. This paper will summarize what is known of the Schappeller device's history, structure, and means of operation.

Karl Schappeller (1875-1947) literally went from being born in a poor house to owning a castle during his lifetime. His economic success was mirrored in his experiments in energy as a lay scientist, culminating in the invention of a free-energy device which attracted considerable attention around 1930. Schappeller made no secret of his invention and actively sought private financing to manufacture and distribute the results of his research. He was in touch with financial concerns and even spoke with a representative of the British Admiralty concerning the utilization of his device to power the Royal Navy's ships.[1]

In 1930, the device was somehow appropriated and further worked upon by a government organization of the German Weimar Republic, the Reichsarbeitsgemeinschaft or Reich Works Association (RAG). At least one aim of the RAG was to make Germany self-sufficient in energy production. Specifically, they published their intentions to utilize many Schappeller devices in a system of broadcast energy distribution throughout Germany which would result in the entire elimination of the electrical grid.[2] As we know, Adolf Hitler assumed power in 1933 and was also very interested in making Germany independent of foreign sources of energy for strategic reasons. It is known that political and scientific structure was set up to work on the energy problem, as evidenced later by the synthesizing of gasoline and oil products from coal by the Third Reich. One of these political and scientific structures was contained within the SS and it is known that Karl Schappeller actually met with SS Reichsfueher Heinrich Himmler in Vienna in 1933.[3]

Fortunately, there are good descriptions of the Schappeller device in both German and English languages upon which to draw. *Der Vril-Mythos* is a complete discussion of Schappeller, his device, the history, and the controversy surrounding it. *"Vril" Die Kosmiche Urkraft Wiedergeburt von Atlantis* and *Weltdynamisus Streifzuege durch technishes Neuland an Hand von biologischen Symbolen* represent an attempt by the RAG to popularize their ideas in booklet form. Finally, British electrical and mechanical engineer, Cyril W. Davson, visited Karl Schappeller in Austria and spent three years learning of his device and his theory before the Second World War. Davson's book, *The Physics of the Primary State of Matter,* was written in 1955, after the war and death of Schappeller.

Before describing the device itself it should be understood that Schappeller and all writing about his device do so believing that the energy source being tapped is ether energy, sometimes called "Ramkraft" or "Raumenergie," that is space energy.[4-6] This device was also said capable, perhaps with some tuning, of emitting ether as a radiant energy.[7] The physics of ether energy is described by Davson as a primary physics, as opposed to conventional physics which he believed could only be considered a secondary, derivative understanding.

— Structure of the Schappeller Device —

According to Davson's description, upon which we will rely, the Schappeller device is really composed of two separate units, the rotor and the stator. The stator is constructed as follows: Its surface is round or ball-shaped, being composed of two half-shells of steel. These half-shells contain the internal structure and are air tight. Attached at each "pole" of each half-shell is an iron bar magnet, most of whose structure is internal. This means that the bulk of the magnet is inside the steel ball, one opposite the other. There is a space between the two bar magnets at the very center of the sphere.

Insulation, a ceramic material, is placed on the inside of the steel ball, leaving a hollow central area. Within this hollow area and around the space between the magnets are wound two internal coils. These originate at the bar magnet poles and each terminates at the center of the sphere with a connection leading out of the sphere to the rotor. These coils are composed of a hollow copper tube filled with a special and secret substance called the "electret." Upon leaving the sphere the electret filled copper tubes are replaced by conventional copper wire. An electrical con-

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nection is made from the outside surface of one pole to one pole of a special type of battery which is grounded at the other pole or, as an alternative, to a special device called an "Ur-machine," which will be discussed.

This electret is a permanent magnet within the sphere. This type of magnetism is not identical with ferro-magnetism or electromagnetism, it is much stronger.[8] The actual composition of Schappeller's electret remains a secret, but another electret has been made by Professor Mototaro Eguchi. It consists of carnauba wax and resin, perhaps also containing some beeswax. It was kept in a strong electric field while baking slowly until it solidified. For purposes of production of Schappeller spheres, a complete electret manufacturing plant would have to be set up which had no parallel in present science.[9]

Before being set into operation, all the air is pumped from the hollow core of the sphere. This whole ball is mounted on a swivel mechanism so that the poles can be moved from the vertical to the horizontal. The stator is completely unattached from the rotor. The stator can function without the rotor and the stator is capable of producing electrical energy without the rotor. The rotor could also be used to generate additional electrical energy.

The rotor consists of: A steel wheel of special design fixed on the shaft to be driven and surrounded on its outer surface by magnets which are attracted and repelled by the force of the stator. The copper wire attached to the internal copper tubing filled with electret runs through this wheel and supplies electric power to the magnets. The magnets are hollow and filled with the same electret. There are always an odd number of magnets.

A variant of this rotor comes to us from Taeufer, who refers to this further development as the "Ur-Machine." This machine is composed of six sphere units as described above, five revolving around a sixth set above or below the plane of the other rotating five spheres and so would be offset, and not attached to the others. The five rotating spheres would charge the sixth stationary sphere. The sixth and seventh spheres would function as an anode and cathode and so ground the unit. The Ur-machine could be used to activate other spheres instead of a battery-earthing procedure mentioned above.[10]

As a prime mover, an engine, the rotor would be employed turning a driven shaft. The stator would be offset, that is, moved off center in relation to the rotor. Schappeller worked out various angles of efficiency.[11] The driven shaft could be used to power any number of machine applications such as, for instance, the propeller of a ship.

— Means of Operation —

The device is started through a totally unique battery and a connection to the earth.[12] A specific excitation impulse must be given to the device.[13] This electric impulse was conducted through the iron magnet and jumped the gap in the center of the sphere to the other iron magnet.

What occurred then sets this device apart from all others. In the vacuum of the sphere, in the center space between the two bar magnets, a field of "glowing magnetism" was set up. This glowing magnetism was something entirely unique. It is recognized as a magnetic field, but much more powerful and unlike any magnetic field of an iron bar or an electric coil. Once the initial input had been made to start the device, the battery and ground could be disconnected. The device would continue to operate on its own.[14]

For an understanding of what is really happening here we have to consider the bar magnet. We think of a bar of iron with two poles, one positive and one negative or perhaps one north and one south pole. But there are really three components to the bar magnet. There are the two poles and the neutral zone between the poles. If we cut the magnet in half, we get two new poles. For the Schappeller device, this neutral area is very important. Imagine a bar magnet running through the vertical axis of the ball. Then imagine the center section cut out. We now have a north pole at the top of the ball, a south pole, opposing the north pole at the top of the ball and, likewise, a north pole opposite the south pole at the bottom of the ball. We have now four poles and a split bar magnet with a gap in its center section.

It is this gap in the center where Schappeller's "glowing magnetism" is generated by grounding, that is, charging the device via a special battery and an earth connection. This glowing magnetism is the mystery. Davson cites Schappeller's calculations and gives this form of magnetism as being one thousand times more powerful than that produced by present magnetism.[15] He also states that in this form of magnetism the electricity is stationary while the magnetism is radiated.[16]

To repeat again, Davson contends throughout his book that this glowing magnetism is not found in secondary physics, that is, in modern physics, and that this glowing magnetism is a manifestation of primary physics. As a phenomenon of primary physics, it is responsible for and can generate heat, electricity, and magnetism.

After the initial stimulation and in a state of glowing magnetism, no further input of energy is needed from the battery. The device is able to draw in energy to it directly from the surrounding ether, bind this energy through its magnetic electret material, that is, the filling in the hollow copper coils of the internal coil, and then re-radiate energy producing heat, electricity, magnetism, or mechanical work depending upon the application.

Stated another way, this is an implosion device and it is described as such.[17,18] Unlike the Schauberger device, which is associated with the word implosion, the Schappeller device operates purely at the energetic level. Energy is drawn towards the center, through the magnets, into the field of glowing magnetism, and then radiated outward.

My pet explanation for this output of radiant energy involves the concept of the Bloch Wall. A Bloch Wall is defined by Van Nostrand's *Scientific Encyclopedia* (1958 edition, pp. 201-202) as follows:

> This is a transition layer between adjacent ferromagnetic domains magnetized in different directions. The wall has a finite thickness of a few hundred lattice constants, as it is energetically preferable for the spin directions to change slowly from one orientation to another, going through the wall rather than to have an abrupt discontinuity.[18]

In electromagnetics, the Bloch Wall is external to the hardware itself. It is the point of division of the circling vortex, or spin, of the electronic magnetic energies of the north and south poles. The negative north pole magnetism spins to the left while the positive south pole spins to the right. Energy is being conducted into the Schappeller device through the

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uninsulated poles and being conducted and spun on its way to the center of the unit. The point of zero magnetism, no spin and magnetic reversal, where the two spin fields join is the Bloch Wall.[19]

The Bloch Wall radiates energy. Remember, if energy is coming in then it must be going out. The Bloch Wall may generate radio, radar, and other electromagnet frequencies, but what is most interesting is that it is actually able to radiate gravity as according to Dr. Richard Lefores Clark. According to this interpretation, the conjunction of two dipolar generated force interpretation, the conjunction of two dipolar generated force field vectors, a quadrapole force field or gravity is generated. Gravity is a quadropole source and radiates in a circular, 360° pattern of two cycles. Dr. Clark has fixed the point of emission as below that of radar and above infrared at 10^{12} Hertz.[20] Dr. Clark believes gravity is a radiation[21] and so a "push" which, in my interpretation of the Schappeller device, is simply a re-radiation of this fundamental ether energy.

The Schappeller device is certainly not holding or retaining some sort of static charge from a battery. It is generating pulses, that is, waves. As mentioned, according to Dr. Clark, in order to generate gravity waves, we must expect a frequency of 10^{12} Hertz. Schappeller, according to Davson, estimated the frequency might be a factor of the use for the extended output. For instance, the use of the Schappeller device for turning the propellers of a ship might require a different frequency than that for electrical generation.

Since the readers of this publication constitute a technically sophisticated audience, this writer would be very interested in and welcome other opinions concerning the workings of this device.

— Other Uses Planned for the Schappeller Device — As mentioned above, in 1930 this device was planned as a source of broadcast energy, reminiscent of Tesla, for both German homes and industry. The device could also be used as a generator, battery, transformer, or antenna.[23] It is reported that toward the end of the war the SS researched the possibility of using this device in the form of a death ray.[24] But perhaps the most controversial proposed utilization for the Schappeller device was for purposes of levitation. Following is some of that discussion, from *"Vril" Die Kosmische Urkrft Wiedereburt von Atlantis* by Johannes Taeufer (p. 48):

> The new dynamic technology will, in the future, be able to drive electric locomotives and automobiles without the manufacture of costly armatures and everywhere through connection to the atmospheric voltage network. Hypothetically, is certainly the installation of a sufficient number of central amplification facilities which transports from the Ur-Machine the specific magnetic impulse from the dynamic spherical element. New types of aircraft with magneto-static power devices and steering,

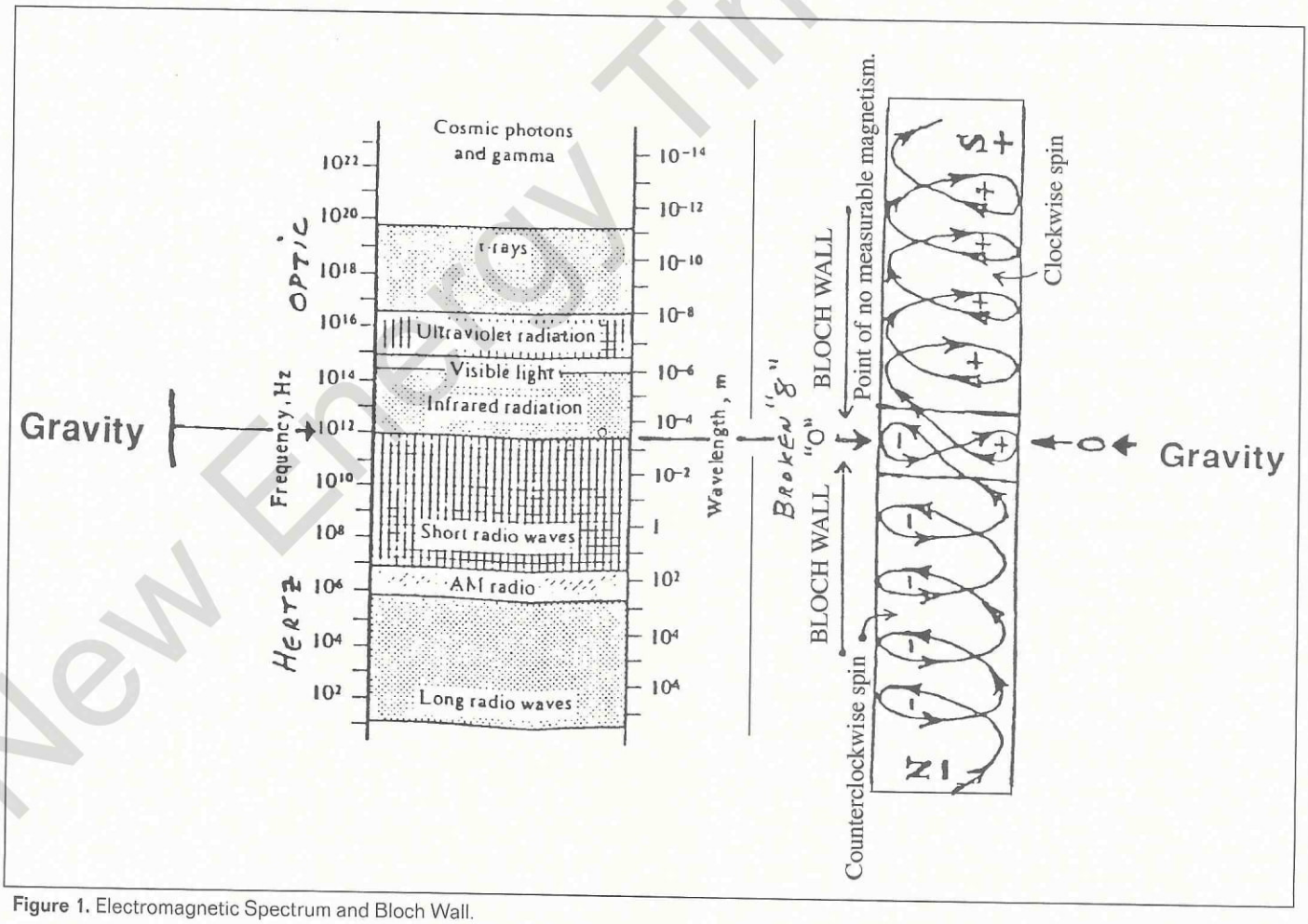

Figure 1. Electromagnetic Spectrum and Bloch Wall.

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which are completely crash and collision proof, could be built for a fraction of the cost of today's aircraft—and without the lengthy training of everyone who will be servicing these aircraft.

From *Weltdynamismus Streifzuege durch technisches Neuland an Hand von biologischen Symbolen* (p. 11 and 12):

> Our problem must be to drive toward the space ship problem to new understanding of a realization! Here a definite postulate can be established: "Spherical space ship with its own atmosphere—also technical creation of small planets with world-dynamic propulsion and buoyancy! Will this be possible?—Major powers in the world prepare themselves in any case presently, especially in Germany."

Please note the use of the words "spherical space ship" (Kugelraumschiff).

From Davson in *The Physics of The Primary State of Matter* (p. 240):

> The Rotor is laminated to prevent eddying and the magnets do not project; the Rotor periphery is thus entirely equiradial. The Rotor is fixed to the shaft to be driven and the Stator is fixed about a metre above the earth's surface. The latter is, of course, flexible because the earth can include the sea or even the floor of an ether-ship.

From Davson (p. 199):

> As has already been explained, the new Technique will not concern itself with the air as a supporting medium, but directly with the ether. Therefore, the body may be a vertical sealed cylinder with conic ends or any other suitable form. Such a body is obviously rigid and inelastic, and it must contain an ether stress of sufficient intensity to support its mass against the ether stress of the earth's stressfield, which means that the glowing magnetism core in the Stator, provided in the body to be lifted, must be able to vary its intensity according to the height at which the ether-ship is to be raised and supported whilst in transit, as the ether stress or field, itself, varies inversely as the square of the distance from the earth's surface. The actual design and solution of all the various problems in the production of such ships, the choice of methods of propulsion, whether independent or directional, belong to the new Technique, whereas here we are only interested in the principle as applied to the problem of Gravitation.

Finally, from Davson (p. 177):

> Now the reason that an unsupported body falls to the ground is primarily because it has "no hold" on the medium. It was previously explained that any inert mass or body has only a latent stressfield which functions merely as the force of cohesion and has no mobility and thus only a latent internal stressfield and no external stressfield. This means that it has no "hold" on any elastic medium such as the ether or the air, therefore it must fall, and it falls towards the greater inductive energy.

If the inductive energy, through some exterior cause, could be made suddenly to increase enormously, there would come a point when the body would be supported, or rather suspended, before it reached the earth's surface.

The new Technique could accomplish this by placing a Schappeller Stator in the body in question, where the body is suitably constructed, thus setting up a glowing magnetic stressfield which would hold or keep the weight or mass of the unit body suspended, not in the air—the stressfield would have no reaction on the air—but only on the earth's magnetic stressfield.

This is the basis of the new principle for "ether ships."

— Was Dr. W.O. Schumann Involved? —

Returning to the earth, it must be noted that none other than Professor Winfried Otto Schumann may have been involved in this research. We are speaking of the same Dr. W.O. Schumann, for whom the Schumann Resonance is named.

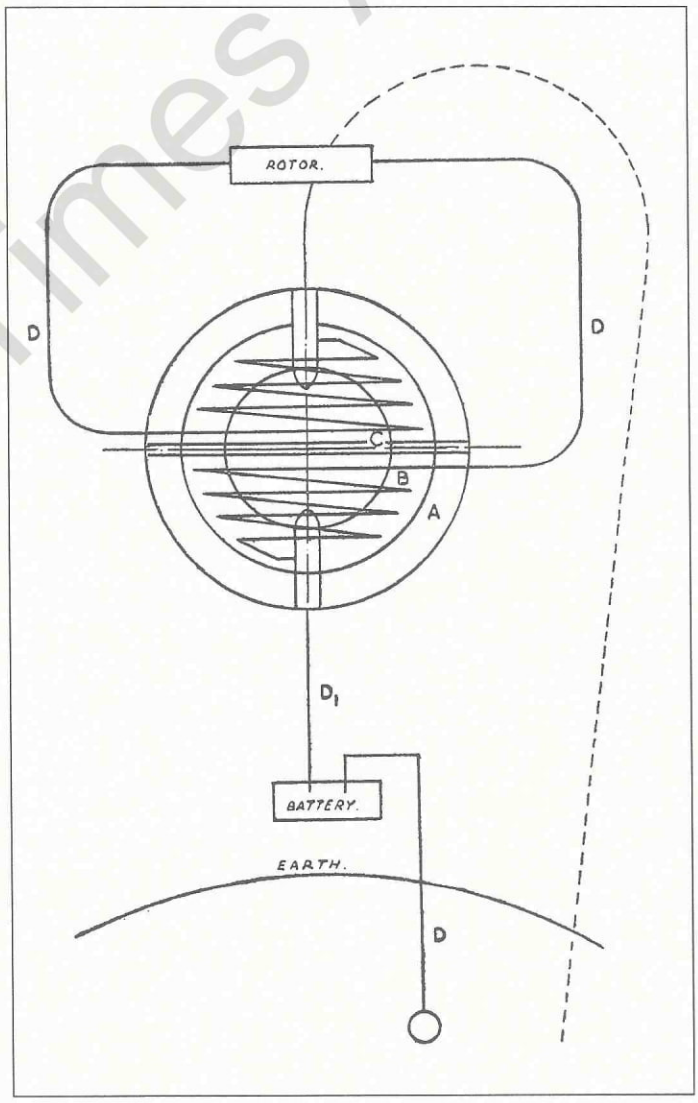

Figure 2. Diagram of Schappeller Device. A= Steel outer casing. B= Special ceramic lining in which tubes are embedded. C= Hollow center with poles; filled with "glowing magnetism," when stator is in operation. D= Tubes, circuit and "earthing" as explained in the text.

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Dr. Schumann described a radio frequency device with some characteristics in common with the Schappeller device in his paper titled "Ueber die zeitliche Form und das Spektrum ausgesendeter Dipolsignale in seiner dielektrischen Holhldugel mit leitenden Waenden mit besonderer Anwendung auf atmosphaerische Signale" ("Concerning the Present Form and Spectrum of Transmitted Dipole Signals in a Dielectric Hollow Sphere with Conducting Walls with Special Application for Atmospheric Signals").[25]

Additionally, beginning in 1936 and continuing until at least 1943, Dr. Schumann was engaged in building a special battery at the Technical Institute in Munich.[26] He received funding for this directly from the Deutschen Forschungsgemeinschaft, forerunner of the Reichsforschungrates, the Reichs Research Council, which coordinated high-priority war research between academic, industrial and military facilities. Why would a senior scientist be involved in building a battery unless it was unique and intended for a unique purpose? Could this have been the battery needed to activate the Schappeller device?

It should be noted that Dr. Schumann was no stranger to free-energy devices. In 1926 he was asked to assess the merits of the Hans Coler device, for which he could find no fault. Dr. Schumann's report on the Coler device, was included in the British Intelligence Objectives Sub-Committee Report concerning Hans Coler and his device to "Raumenergie."[28] Both devices conducted energy through bar magnets and may have used magnetism as a means of energy collection.

— Conclusion —

In the end, what can be said of the Schappeller device? Certainly, it did exist. It drew attention and funding from people within the German government of the time. It was studied by a qualified outsider, a British engineer, for a period of three years and was judged to be genuine.

There are some obvious problems, however. Exotic energies have been evoked which have not been explained satisfactorily and are not currently in evidence. Certainly more proof is required before the claims made for this device can be wholly accepted.

What became of it after the war is unknown. It can be assumed that this device did not escape the scrutiny of the numerous Allied intelligence units tasked with combing Germany for examples of German science. Perhaps someday a government report will be de-classified explaining all this, as it was in the case of another free-energy machine, that being the Hans Coler device, which was declassified by the British in 1978. Until that final reckoning comes, aspects of the Schappeller device will still remain a mystery.

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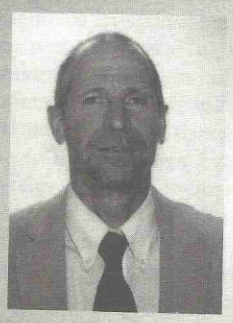
13. Taeufer, p. 30.
14. *Ibid.*, p. 32.
15. Davson, p. 231.
16. *Ibid.*, p. 231.
17. *Ibid.*, p. 57.
18. Taeufer, pp. 38-40.
19. Clark, R.L. 1987. "The Earth Grid, Human Levitation, and Gravity Anomalies," contained in *Anti-Gravity and the World Grid,* edited by David Hatcher Childress, Adventures Unlimited Press, Stelle, Illinois, p. 64.
20. *Ibid.*
21. *Ibid.*
22. Davson, p. 244.
23. Bahn and Gehring, p. 115.
24. *Ibid.*, p. 137.
25. Schumann, W.O. 1956. "Ueber die zeitliche Form und das Spektrum ausgesendeter Kipolsignale in einer deilektrischen Hohlkugel met leitenden Waenden mit besonderer Anwendung auf atmosphaerische Signale," Verlag Der Bayerischen Akedemie Der Wissenschaften, Munich.
26. Bundesarchiv, Postfach 450569, 12175 Berlin, file on Dr. W.O. Schumann, courtesy of Mark D. Kneipp.
27. British Intelligence Objectives Sub-Committee Final Report Number 1043, item number 31, "The Invention of Hans Coler, Relating To an Alleged New Source of Power," Bryanston Square, London.
28. *Ibid.*

About the Author



Henry Stevens received a B.A. in 1970 from the University of California at Los Angeles in Anthropology. After a career in business, he formed the German Research Project in 1990 to research and disseminate information concerning still-secret or suppressed science and technology developed in Germany during the Third Reich.

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Astronomical-Archeological Anomalies on Two Planets

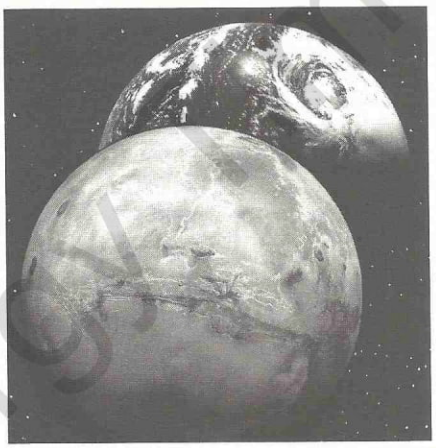
Eugene Mallove

We are proud to present the following remarkable scientific papers, which we anticipate will stimulate *IE* readers and provoke controversy:

"Terrestrial Evidence of a Nuclear Catastrophe in Paleoindian Times" by R. Firestone and W. Topping

"Evidence of Planetary Artifacts" by T. Van Flandern *et al.*

It happens that the articles concern archeo-astronomical anomalies on two planets, Earth and Mars, hence this combined introduction. The first article, which I believe may have significant *direct* energy implications (as well as significant global security implications), is reprinted with kind permission from the peer-reviewed archeology quarterly news magazine, *Mammoth Trumpet*. We are sorry to report that the second article, despite its extremely careful scientific treatment of controversial images gathered by NASA spacecraft, was rejected outright by *Nature* magazine (and subsequently by Science), apparently because such a topic—possible artifacts on the Martian surface—is *a priori* "off limits" to discussion in those esteemed journals. In other words, those publications each have, in effect, an Index of Forbidden Topics. This was a scientific discovery in its own right: that these "journals of record" have particular topics which the editorial staffs have determined do not warrant processing by their so-called peer-review systems. That was confirmed orally in the case of *Nature,* by the words of a London-based editor. For *Science,* its Index was discovered *de facto.* We hereby issue this challenge to *Nature* and *Science:* Publish your index of forbidden topics so that your time and energy and that of frontier scientists will no longer be wasted! (We trust that cold fusion and all new energy experiments and theories are on these lists, but who knows?)



For many months, this editor has been in contact with co-author of the first paper, Dr. William Topping, whose Ph.D. is in archaeology. In addition to the article which we publish here, Dr. Topping has done extensive gamma ray and calorimetric testing of a possible new nuclear process, which he (*not* his co-author) derived by "reverse-engineering" the apparently natural, catastrophic astronomical process—the hypothetical one that gave rise, in part, to the widespread nuclear dating anomaly that he and R.B. Firestone of Lawrence Livermore National Laboratory report in the reprinted article. He has not published those results, but has shared them with me and others.

The process, if Topping's characterization is valid, may be described as "micro-fission," the ability of certain material coatings of uranium-containing particles to participate in heat generation and radioactive nuclide-producing reactions. The small-scale laboratory demonstrations of this alleged process produce *persisting* temperature elevations above ambient in small dewar vessels containing nuclear moderating materials and specially engineered particulates. The perhaps unwelcome finding of these experiments—*if* they are valid—is that fissionable materials (such as U^{235} and Pu^{239}) might be created in quantity by relatively simple means. Dr. Topping summarized his process to me recently: "Thousands of gamma runs, and associated radiochemistry, suggest that a new fission process has been developed. In particular, 'gamma flash' tests which assume ~ 25 gammas from each fission of U^{235} (or other isotope) indicated that depending on the particular degree of moderation and other factors, the 'critical mass' and 'mean free path' required for fissions can be substantially reduced. Most interesting, it appears that protactinium is being destroyed by neutron capture, and in turn that uranium is being manufactured through the protactinium series." Dr. Topping has brought this matter to the attention of numerous Federal agencies (FBI, Nuclear Regulatory Commission, etc.) and has been met with stony silence and lack of interest. Either the officials do not believe his results *a priori,* or they are too inept to recognize the serious implications of the alleged process—both beneficial and destructive. Furthermore, efforts by Topping to interest companies involved with fission nuclear power and materials processing have so far come to naught.

The more direct implications of the Topping-Firestone article are dramatic as well. To explain the archeological anomalies of too young carbon-14 dates in artifacts from particular strata, the authors offer as one possibility the irradiation by a nearby supernova in pre-historic times, which might have caused the carbon clock re-setting as well as the anomalous distortion of the U^{235}/U^{238} abundance ratio. They also write, "Much of what we assume about the Paleoindian period and the peopling of the Americas has been inferred from conventional radiocarbon chronology, which often conflicts with archeological evidence. This work mandates that conventional radiocarbon dates be re-interpreted in light of hard terrestrial evidence of exposure of the radiocarbon samples to a cosmological catastrophe that affected vast areas of North America and beyond."

Concerning the imagery from the Cydonia region of Mars assessed by astronomer Dr. Tom Van Flandern and his group in their paper (and in extensive website material referenced therein), in particular the "Mars face" mesa, it is in my view a compelling analysis. Each reader will draw his or her own conclusions about the strength of the arguments in the article. However, it seems to this editor more likely than not that an extraterrestrial culture, of unknown origin and fate, performed large-scale surface modification of the Martian surface. Certainly, the *possibility* of extraterrestrial artifacts on Mars deserves the most thorough investigation before ruling it out. Obviously, given the inappropriate reaction of mainstream scientists such as populate the established organs *Nature* and *Science,* this is not happening. The marginalization of these potential artifacts by NASA, JPL, and the so-called SETI community (seekers of microwave or optical signals from beyond the Solar System) is pathetic and unscientific. But it is *they* who control and influence the major sources of funding, both public and private.

In last issue's "Eclectic Observer" section, we discussed the emerging significant evidence for *extant* life forms on Mars. These lines of evidence receive only slightly better treatment by the mainstream. The good news is that the inexorably expanding exploration of the Solar System, Mars in particular, is likely to provide welcome answers to these questions—in spite of the obstruction by critics. It is sad but true that earlier recognition of these tantalizing findings might have prompted much greater planetary space exploration by now. Ironically, the very promoters of increased planetary exploration have been the greatest obstacle to progress in the search for extraterrestrial life—just as the best funded promoters of fusion energy, the hot fusioneers, have been the greatest enemies of the most workable fusion process, cold fusion. It appears that *homo absurdus* is the truly dominant species on this beautiful blue-green world. ■■■

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Terrestrial Evidence of a Nuclear Catastrophe in Paleoindian Times

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Richard B. Firestone*
William Topping**

The Paleoindian occupation of North America, theoretically the point of entry of the first people to the Americas, is traditionally assumed to have occurred within a short time span beginning at about 12,000 yr B.P. This is inconsistent with much older South American dates of around 32,000 yr B.P.[1] and the similarity of the Paleoindian toolkit to Mousterian traditions that disappeared about 30,000 years ago.[2] A pattern of unusually young radiocarbon dates in the Northeast has been noted by Bonnichsen and Will.[3,4]

Our research indicates that the entire Great Lakes region (and beyond) was subjected to particle bombardment and a catastrophic nuclear irradiation that produced secondary thermal neutrons from cosmic ray interactions. The neutrons produced unusually large quantities of ^{239}Pu and substantially altered the natural uranium abundance ratios ($^{235}U/^{238}U$) in artifacts and in other exposed materials including cherts, sediments, and the entire landscape. These neutrons necessarily transmuted residual nitrogen (^{14}N) in the dated charcoals to radiocarbon, thus explaining anomalous dates.

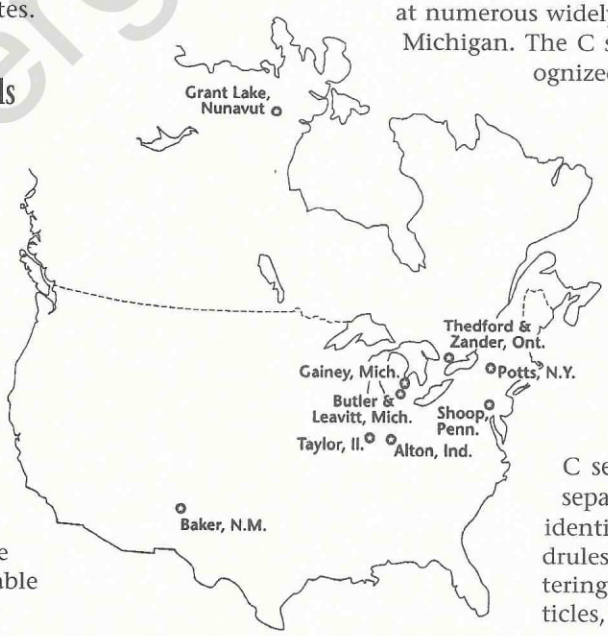
The Evidence from Dated Materials

We investigated a cluster of especially young radiocarbon dates concentrated in the north-central area of North America. For example, at the Gainey site in Michigan a 2880 yr B.P. radiocarbon date was reported, while the thermoluminescence date for that site is 12,400 yr B.P.[5] Other anomalous dates found at Leavitt in Michigan,[6] Zander and Thedford in Ontario,[7] Potts in New York,[8] Alton in Indiana,[9] and Grant Lake in Nunavut[10] are summarized in Table 1. The Grant Lake Paleoindian site is most remarkable because its 160 [rc] yr B.P. age is nearly contemporary, while adjacent and deeper samples give ages of 1480-3620 [rc] yr B.P.

Stratigraphic associations place Paleoindian occupations at depth on the prehistoric North American landscape on sediments that form the old C horizon composed of parent material, Wisconsinan deposits that predate Holocene sediment buildup.[11,12,13] The young Paleoindian dates cannot be correct, particularly since there are no patterned anomalies noted in later-period prehistoric assemblages relating to higher stratigraphic positions. In a pioneering study of the Paleoindian site at Barnes, Michigan, Wright and Roosa observed that Paleoindian artifacts were deposited before the formation of spodosols ceased in this area about 10,000 yr B.P.[14] This conclusion was based on observing that cemented sediments on artifacts, found outside their original context, defines their original stratigraphic position.

The Evidence from Particle Bombardment

Sediment profiles were taken at Paleoindian sites and at numerous widely separated control locations in Michigan. The C sediment horizon is clearly recognized by its transitional color and confirmed by elevated concentrations of potassium and other isotopes. Color and chemistry are key indicators of this very old soil[11,12,13] derived from parent materials and associated post-glacial runoff.[15] At Gainey, large quantities of micrometeorite-like particles appear to be concentrated near the boundary between the B and C sediment horizons. They can be separated with a magnet and are identified by the presence of chondrules and by visual evidence of sintering and partial melting. These particles, dissimilar to common mag-



Sites discussed in this article.

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Table 1. Site and particle impact data for Paleoindian artifacts, charcoals, and cherts.

Site	Coordinates	Particle/track/pit Density /mm²	Depth (μm)	Angle (approx.)	^{14}C date (yr B.P.)	Comments
Baker, N.M.	34.5° N, 106.4° W	130 ± 60	10	90°		pits; artifact
Alton, Ind.	38.7° N, 86.2° W	700 ± 300	60	90°	1860	particles; chondrules; unaltered flake with embedded particles
Taylor, Ill.	39.1° N, 88.2° W	c. 400	60	90°		particles; chondrules; outer flake
Shoop, Pa.	40.4° N, 76.5° W	130 ± 60	5	5°		tracks; flake
Butler, Mich.	42.4° N, 84.3° W					particles; flake
Leavitt, Mich.	42.4° N, 84.3° W	400 ± 90	120	90°	2830 ± 115	particles; tracks; no chondrules; flake
Gainey, Mich.	42.6° N, 83.4° W	460 ± 70	120	90°	2880 ± 175▼	pits; particles; tracks; no chondrules; flake
Thedford, Ont.	43.1° N, 81.5° W				2130 ± 230	
Potts, N.Y.	43.2° N, 76.2° W				3810	
Zander, Ont.	43.4° N, 79.2° W	200 ± 140	60	85°	3380 ± 420	particles; no chondrules; flake
Grant Lake, Nun.	63.4° N, 100.3° W				160 ± 65	

▼12,360 ± 1240 yr B.P. date determined by thermoluminescence

netites, are found in association with a high frequency of "spherules." The depth profiles for potassium and particles at the Gainey site are compared in Figure 1. Minor vertical sorting of particles is apparent, with a shallow spike of particles near the surface probably resulting from modern agricultural or industrial activity. Total gamma-ray counting of sediment profiles in the various locations invariably showed increased radioactivity at the B-C boundary consistent with enhanced potassium (^{40}K) and possibly other activities.

Microscopic examination of chert artifacts from several widely separated Paleoindian locations in North America revealed a high density of entrance wounds and particles at depths that are evidence of high-velocity particle bombardment. Chondrules were identified visually; their presence necessarily indicates heating during high-speed entry into the atmosphere. The depth of penetration into the artifacts implies that the particles entered with substantial energy.[16] Field simulations with control cherts for large particles (100-200 microns) suggest an entrance velocity greater than 0.4 km/s, and experiments at the National Superconducting Cyclotron Laboratory indicate that the smaller particles left tracks comparable to about 526 MeV iron ions (^{56}Fe) in Gainey artifacts. Similar features are not observed in later-period prehistoric artifacts or in bedrock chert sources. Track angles were estimated visually; track densities were measured with a stage micrometer; track depths were found by adjusting the microscope focus through the track. These data are summarized in Table 1.

Track and particle data in Table I suggest that the total track volume (density times depth) is highest at the Michigan, Illinois, and Indiana sites and decreases in all directions from this region, consistent with a widespread catastrophe concentrated over the Great Lakes region. The nearly vertical direction of the tracks left by particle impacts at most sites suggests they came from a distant source.

The Evidence from Uranium and Plutonium

Natural uranium, which is ubiquitous in cherts, has a $^{235}U/^{238}U$ isotopic ratio of 0.72%, which varies by less than 0.1% in natural sources.[17] Significant variations in the isotopic ratio do not occur because of chemical processes; however, a thermal neutron bombardment depletes ^{235}U and thus alters the ratio. Solar or galactic cosmic rays interacting with matter produce fast secondary neutrons that become thermalized by scattering from surrounding materials. Thermal neutrons see a target of large cross section (681 barns) for destroying ^{235}U, compared with a target of only 2.68 barns for neutron capture on ^{238}U. [A barn is a unit of area equal to 10^{-24} cm², used in nuclear physics. The fraction of isotopes that are transformed by a nuclear reaction is given by $\sigma \times I$, where σ is the cross section in cm² of the target presented by an atom, and I is the neutron flux per cm² impinging on the target. Most neutron-induced reactions involve the capture of a neutron to produce a heavier isotope of the same element. Exceptions include ^{14}N, which captures a neutron and emits a proton to produce ^{14}C; and ^{235}U, which mainly fissions into two lighter elements. The relative size of isotopes in chert is shown in the figure entitled "A neutron's view of chert." p. 17] Therefore, despite the low abundance of ^{235}U, about 1.8 times as many ^{235}U atoms are destroyed as ^{238}U atoms by thermal neutrons.

If a large cosmic-ray bombardment impacted the earth and

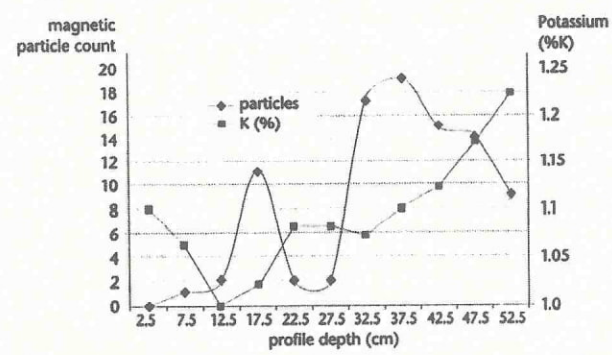

Figure 1. Sediment profile showing the number of magnetic particles and the potassium concentration at the Gainey site. The potassium concentration was determined by ^{40}K gamma-ray counting; the uncertainty is within the plotted points. Particle frequencies were counted under a microscope for 0.25-ml samples at each interval.

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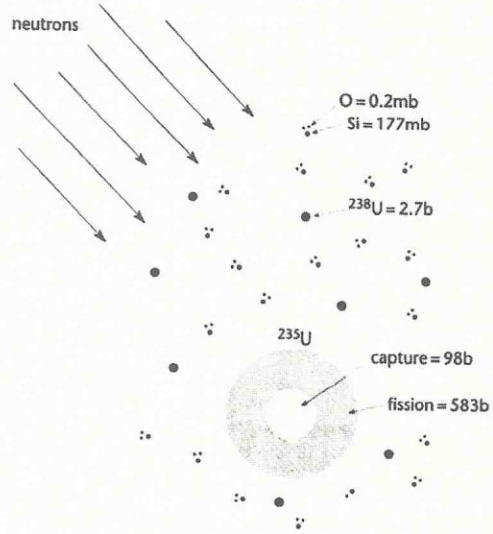
A neutron's view of chert



Chert (SiO_2, silicon dioxide, or silica) is an interesting material. Because silicon and oxygen present small cross sections to neutrons, neutrons are only slowly absorbed in chert. Atoms of uranium, a natural impurity in chert, have much larger cross sections for neutron capture. ^{235}U has a cross section so large that, although it constitutes only 0.72% of all uranium, it presents a larger target and is therefore nearly twice as likely to be destroyed by neutrons as ^{238}U, which is 99.28% of all uranium. This is why ^{235}U becomes depleted in uranium when bombarded by neutrons. (The cross section for ^{14}N—to produce ^{14}C—is about the same as for ^{238}U to capture a neutron.) Since uranium is only a trace impurity in chert, most of the neutrons are captured by silicon atoms, but the neutron flux is attenuated slowly with sample depth. Half the neutrons will penetrate 150 cm of chert, compared with 100 cm for $CaCO_3$, 60 cm for H_2O, and 6 cm for FeO. Thus, in the event of a thermal neutron-producing event, buried artifacts would be irradiated uniformly and would not attenuate neutrons. Carbon in associated charcoals used for radiocarbon dating has a very small cross section for neutron capture (0.0035 barn), which is only 0.02% of the cross section for residual ^{14}N (1.83 barn). Thus, even small amounts of ^{14}N in charcoal will disproportionally absorb neutrons, producing ^{14}C and resetting their radiocarbon clocks.

irradiated the prehistoric landscape with thermal neutrons, the $^{235}U/^{238}U$ ratio would be changed; ^{239}Pu would be produced from neutron capture on ^{238}U, followed by the decay of ^{239}U. Neutrons colliding with nitrogen (1.83 barns) would create ^{14}C in exactly the same way ^{14}C is normally produced in the upper atmosphere, necessarily resetting the radiocarbon dates of any organic materials lying near the surface on the North American prehistoric landscape—*including charcoals at Paleoindian sites*—to younger values. ^{239}Pu produced during the bombardment will also be partly destroyed by thermal neutrons with 1017 barn cross section. Assuming ^{239}Pu doesn't mobilize, it will decay back to ^{235}U (half-life 24,110 yr), partially restoring the normal abundance.

Paleoindian artifacts from Gainey, Leavitt, and Butler, and two later-period artifacts from the same geographic area of Michigan were analyzed for ^{235}U content by gamma-ray counting at the Phoenix Memorial Laboratory, University of Michigan. They were compared with identical chert types representative of the source materials for the artifacts. Control samples were extracted from the inner core of the purest chert known to be utilized by prehistoric people. The Paleoindian artifacts contained about 78% as much ^{235}U as the controls and later-period artifacts, suggesting substantial depletion. *Depletion of ^{235}U necessarily indicates that thermal neutrons impacted these artifacts and the surrounding prehistoric landscape.*

Various artifacts, cherts, sediments, and a control sample containing about 0.2% uranium obtained from uraninite were sent to the McMaster University Centre for Neutron Activation Analysis to determine ^{235}U concentration by delayed neutron counting and ^{238}U concentration by activation analysis. These results are shown in Table 2. The $^{235}U/^{238}U$ ratios for all samples except the control deviated substantially from the expected ratio. McMaster ran additional calibration standards and has considerable expertise analyzing low-level uranium. This analysis was sensitive to a few ppb for ^{235}U and 0.1-0.3 ppm for ^{238}U, more than sufficient to precisely analyze the uranium-rich chert samples (0.7-163.5 ppm). Most samples were depleted in ^{235}U, depletion increasing geographically from the southwest (Baker, Chuska chert, 17%) to the northeast (Upper Mercer, 77%), as shown in Table 2. This is consistent with cosmic rays focused towards northern latitudes by Earth's magnetic field. Only a very large thermal neutron flux, greater than 10^{20} n/cm^2, could have depleted ^{235}U at all locations.

Samples of unaltered flakes from

Table 2. Uranium and plutonium data for Paleoindian artifacts, cherts, sediments, and standards. Sites are ordered by increasing latitude.

Site	Sample	Total uranium (ppm)	$^{235}U/^{238}U$ Ratio (%)	^{235}U Depletion (%)	$^{239}Pu/^{238}U$ (ppb)
Control	uraninite	2269 ± 112	0.73 ± 0.04	< 5	
Baker	artifact	163.5 ± 7.6	0.59 ± 0.03	19 ± 4	
Baker	Chuska chert	129.0 ± 6.5	0.60 ± 0.03	17 ± 4	
Alton	flake	56.3 ± 2.7	0.60 ± 0.03	17 ± 4	
Alton	Wyandotte chert	7.7 ± 0.5	0.51 ± 0.06	30 ± 8	
Taylor	outer flake	note a	0.95 ± 0.03	note b	10 ± 1
Taylor	inner flake	8.2 ± 0.5	0.59 ± 0.06	19 ± 8	
Butler	flake	4.6 ± 0.5	0.37 ± 0.12	49 ± 17	
Leavitt	flake	0.6 ± 0.2	<0.5	>30	
Leavitt	Bayport chert	8.1 ± 0.5	0.42 ± 0.06	42 ± 8	
Gainey	sediment	1.39 ± 0.09	0.94 ± 0.09	note b	43 ± 4
Gainey	flake	0.7 ± 0.2	< 0.4	>45	c. 90
Gainey	inner artifact■	1.6 ± 0.2	<0.15	>79	
Gainey	Upper Mercer chert	1.8 ± 0.3	0.17 ± 0.12	77 ± 17	
Zander	flake	1.0 ± 0.2	<0.25	>65	

[a] 3–13 ppm U, weighted average of six measurements.
[b] Enriched in ^{235}U.
■ Acid-reduced flake core with micrometeorites removed.

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Taylor and sediment originally adjacent to Gainey artifacts showed ^{235}U enriched by 30%. Both samples were closely associated with the particles described above. The position of these samples appears to be related to the enrichment, which cannot be explained by thermal neutrons from the bombardment. To test this, we bathed another Taylor flake in 48% HF at 60°F for ten minutes to remove the outer 70% of the sample and the attached particles. Analysis showed the "inner" flake depleted in ^{235}U by 20%, consistent with the other depleted cherts.

Samples of Gainey sediment and Taylor flakes were analyzed for plutonium by Nuclear Technology Services, Inc., of Roswell, Georgia, which specializes in radiochemistry using standard methodology. The plutonium, with an aliquot of NIST-traceable ^{242}Pu added, was chemically separated on an anion exchange resin column and counted on an alpha-particle spectrometer. The $^{239}Pu/^{238}U$ ratios in both samples were approximately 10 ppb, vastly exceeding the expected ratio of 0.003 ppb.[18] The results of this analysis are shown in Table 2.

Chert is a glass-like material highly impervious to penetration by any nuclear fallout that might also contribute ^{239}Pu. We analyzed a long-exposed piece of Bayport chert by gamma-ray counting at the LBNL low-background facility for the presence of cesium-137 (^{137}Cs), a key indicator of fallout (from nuclear testing), and found none. The B-C interface typically lies sufficiently deep that contamination by fallout is improbable. It is important to note that *fallout cannot explain the depletion of ^{235}U.*

Since the depletion of ^{235}U must have resulted from bombardment by thermal neutrons, the presence of ^{239}Pu from irradiation of ^{238}U is expected. The total thermal neutron flux required to produce the observed ^{239}Pu concentration can be calculated from the relative concentrations of ^{239}Pu (corrected for the decay) and ^{238}U, and the thermal neutron-capture cross section for ^{238}U. This neutron flux can then be used to estimate the amount of additional ^{14}C that would have been produced in charcoal by neutrons colliding with ^{14}N (^{14}N cross section = 1.83 barns). The corrected radiocarbon age can then be estimated by comparing the current amount of ^{14}C in the dated charcoals, determined from their measured radiocarbon age, with the amount of ^{14}C that would have been produced by the bombardment. For these calculations we assume that charcoal contains 0.05% residual nitrogen[19] and that initial ^{14}C concentrations were the same as today (one ^{14}C atom for 10^{12} ^{12}C atoms).

We derive a thermal neutron flux of c. 10^{17} n/cm^2 at Gainey, which corresponds to an approximate date of 39,000 yr B.P. No radiocarbon date is available for the more southerly Taylor site, but for the conventional range of accepted Paleoindian dates the neutron flux would be c. 10^{16} n/cm^2, giving a date of about 40,000 yr B.P. These calculations necessarily neglect differences in the neutron flux experienced by the dated charcoal and the artifacts, the effects of residual ^{239}Pu from previous bombardments, and loss of ^{239}Pu due to leaching from chert over time.

The neutron flux calculated from the $^{235}U/^{238}U$ ratio is more than 1000 times that implied by the level of ^{239}Pu. Since ^{239}Pu decays to ^{235}U, partly restoring the natural abundance, it appears that substantial quantities of ^{239}Pu have migrated out of the chert. This mobility is demonstrated at the Nevada Test Site, where plutonium, produced in nuclear tests conducted by the U.S. between 1956 and 1992, migrated 1.3 km.[20] It has also been shown that atoms produced by radioactive decay or nuclear reaction become weakly bound to the parent material and pass more readily into solution than isotopes not affected.[21] Both ^{239}Pu and ^{235}U are thus expected to be mobile, complicating any analysis. This is consistent with the enrichment of ^{235}U in the two external samples where migrating ^{239}Pu or ^{235}U may have been trapped, thus enriching the relatively uranium-poor outer regions. Alternatively, excess ^{235}U may have been carried in by the particles. Radiocarbon produced *in situ* by irradiation should also be mobile. If ^{14}C is more mobile than ^{239}Pu, then the dates calculated above should be decreased accordingly.

Redating North American Sites

The 39,000 yr B.P. date proposed for the Gainey site is consistent with the prevailing opinion among many archaeologists about when the Americas were populated. It is also commensurate with dates for South American sites and with a Mousterian toolkit tradition that many see as the Paleoindian precursor. The proposed date for the Gainey site also falls closer in line with the radiocarbon date for a Lewisville, Texas, Paleoindian site of 26,610 ± 300 yr B.P.[22,23] and radiocarbon dates as early as c. 20,000 yr B.P. for Meadowcroft Rockshelter.[24] Since the Lewisville and Meadowcroft sites were likely exposed at the same time to thermal neutrons, we estimate that their dates should be reset to c. 55,000 yr B.P. and c. 45,000 yr B.P., respectively.

It is likely that Paleoindians occupied low latitudes during the full glacial and migrated to more northerly areas as the ice front retreated. Therefore the pattern of dates makes sense from the archaeologist's point of view. Dates for North American sites should generally be reset by up to 40,000 years, depending on latitude and overburden.

Geologists believe that before c. 15,000 yr B.P. the Wisconsinan glaciation covered the more northerly locations where Paleoindian sites have been found.[25] The ice sheet would have shielded the landscape and any artifacts from an irradiation. (The Gainey thermoluminescence date of 12,400 yr B.P. is probably a result of the heat generated by the nuclear bombardment at that time, which would have reset the TL index to zero.) The modified dates for Paleoindian settlements suggest that the timetable for glacial advance sequences, strongly driven by conventional radiocarbon dates, should be revisited in light of the evidence presented here of much older occupations than previously thought.

The Evidence from Tree Rings and Marine Sediments

A large nuclear bombardment should have left evidence elsewhere in the radiocarbon record. It is well known that radiocarbon dates are increasingly too young as we go back in time. The global Carbon Cycle suggests that ^{14}C produced by cosmic rays would be rapidly dispersed in the large carbon reservoirs in the atmosphere, land, and oceans.[26] We would expect to see a sudden increase in radiocarbon in the atmosphere that would be incorporated into plants and ani-

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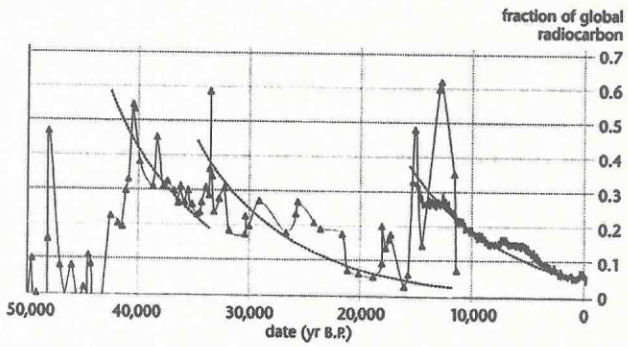

Figure 2. INTCAL98 radiocarbon age calibration data from Stuiver *et al.* (jagged curve), and Icelandic marine ^{14}C data (Voelker *et al.*[31]) for 50,000-11,000 yr B.P. (triangles) were independently fit assuming a constant galactic cosmic ray-induced ^{14}C background plus residual radiocarbon decaying from nuclear events at 41,000, 33,000, and 12,500 yr B.P. The residual ^{14}C is plotted as a fraction of total observed ^{14}C (global radiocarbon), assuming equilibrium was rapidly achieved over the time scale of the measurements. Global carbon, primarily dissolved in the oceans, thoroughly mixes over a time scale of centuries. The smooth curves show the expected decay curves for the three events assuming ^{14}C half-life = 5730 yr. The fit to the data gives 6120 yr (12,000-0 yr B.P.), 6020 yr (32,000-16,000 yr B.P.), and 5750 yr (37,000-34,000 yr B.P.). Fluctuations in the measurements from the decay curves may result from variations in ocean temperatures and currents. The sharp drop in ^{14}C activity before 41,000 yr B.P. suggests that this series of events was initiated by an event that increased global ^{14}C by about 45%, followed by two events each increasing ^{14}C by about 20%. About 7% of modern radiocarbon is residue from these early events. The galactic cosmic ray ^{14}C background component was about 34% larger for the Icelandic data, consistent with a higher expected cosmic ray flux at Northern latitudes.

mals soon after the irradiation; after only a few years, most of the radiocarbon would move into the ocean reservoirs. The ^{14}C level in the fossil record would reset to a higher value. The excess global radiocarbon would then decay with a half-life of 5730 years, which should be seen in the radiocarbon analysis of varved systems.

Figure 2 plots ^{14}C from the INTCAL98 radiocarbon age calibration data of Stuiver *et al.* for 15,000-0 yr B.P.[27] and Icelandic marine sediment ^{14}C data measured by Voelker *et al.* for 50,000-11,000 yr B.P.[28] Excess ^{14}C is indicated by the difference between the reported radiocarbon dates and actual dates. Sharp increases in ^{14}C are apparent in the marine data at 40,000-43,000, 32,000-34,000 and c. 12,000 yr B.P These increases are coincident with geomagnetic excursions [The alignment of magnetic particles in sediment indicates that the Earth's magnetic poles have repeatedly reversed their polarity in the past. Complete magnetic excursions occurred about 10 times in 4.5 million years; the last reversal occurred about 700,000 years ago. Magnetic excursions occur every 10,000-20,000 years when the Earth's magnetic field becomes weak, and the poles may even reverse for a short time.] that occurred at about 12,000 (Gothenburg), 32,000 (Mono Lake), and 43,000 yr B.P. (Laschamp),[29] when the reduced magnetic field would have made Earth especially vulnerable to cosmic ray bombardment. The interstitial radiocarbon data following the three excursions were numerically fit, assuming exponential decay plus a constant cosmic ray-produced component. The fitted half-lives of 5750 yr (37,000-34,000 yr B.P.), 6020 yr (32,000-16,000 yr B.P.), and 6120 yr (12,000-0 yr B.P.) are in good agreement with the expected value.

We also determined that contemporary radiocarbon contains about 7% residual ^{14}C left over from the catastrophe. The constant cosmic ray production rate was about 34% higher for the Icelandic sediment than the INTCAL98 samples, perhaps implying higher cosmic ray rates farther north. Disregarding fluctuations in the data from variations in ocean temperatures and currents, the results are clearly consistent with the decay of radiocarbon following the three geomagnetic excursions.

In Figure 2, the sharp drop in ^{14}C activity before 41,000 yr B.P. suggests that global radiocarbon increased by about 45% at that time and by about 20% at 33,000 and 12,000 yr B.P. The results are remarkably consistent with Vogel's comparison of ^{14}C and U-Th dates of a stalagmite that indicates global radiocarbon increased about 75% from 30,000 to 40,000 yr B.P. and about 30% around 18,000 yr B.P.[30]

McHargue *et al.* found high levels of ^{10}Be in Gulf of California marine sediments at 32,000 and 43,000 yr B.P. [Beryllium occurs naturally as ^{9}Be. ^{10}Be is produced by cosmic rays, mostly protons, striking the atmosphere and breaking apart nitrogen and oxygen. It has a half-life of 1.5 million years. Unlike ^{14}C, which is caught up in the global Carbon Cycle, ^{10}Be is inert and falls as dust. ^{10}Be is produced almost entirely by galactic cosmic rays, which are much higher in energy than solar cosmic rays. Thus any increase in ^{10}Be would be cosmic in origin; and the cosmic ray rate could only change if there were a nearby supernova. During the last Ice Age the ^{10}Be deposition rate in ice at both poles was much higher than today. Gulf of California marine sediments clearly show strong ^{10}Be peaks at 32,000 and 43,000 yr B.P. McHargue argues that these peaks can only be explained by a supernova.] that could not be explained by magnetic reversal alone and were attributed to cosmic rays, possibly from a supernova.[29] The geomagnetic excursion at 12,500 yr B.P. coincides with the thermoluminescence date from Gainey, and additional evidence for a cosmic ray bombardment at that time is found in the increases of ^{10}Be,[31] Ca,[32] and Mg[32] in Greenland ice cores around 12,500 yr B.P. Similar increases are also seen in the data for NO_3^-, SO_4^-, Mg^+, Cl^-, K^+, and Na^+ ions in Greenland ice cores.[33] This occurrence can be dated precisely to 12,500 ± 500 yr B.P., an average of the remarkably consistent concentration peak centroids in the Greenland ice core data. Significant increases at that time are not found in comparable data for the Antarctic, which indicates that the cosmic ray irradiation was centered in the Northern Hemisphere. Weak

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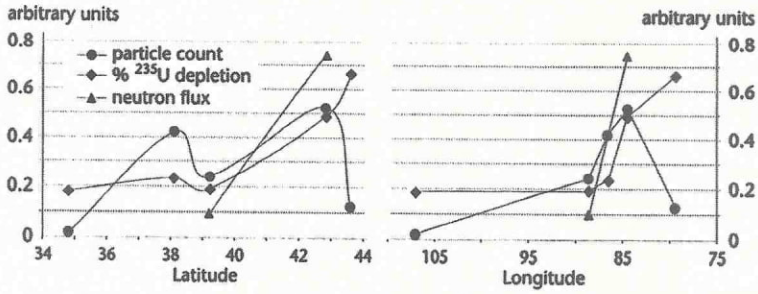

Figure 3. Comparison of relative particle volume, depletion of ^{235}U, and neutron flux as a function of latitude and longitude. The neutron flux is calculated from the measured ^{239}Pu activity and ^{238}U concentration in the chert. The data have been renormalized to a common scale for comparison.

evidence of an occurrence at 12,500 yr B.P. is seen in the radiocarbon record for marine sediments near Venezuela,[34] confirming that the cosmic ray bombardment was most severe in northern latitudes.

Lunar cosmogenic data also show evidence of increased solar cosmic ray activity at or before 20,000 yr B.P.[35,36] although these data are not sensitive to earlier irradiation.

The Effect of a Supernova on Earth

Sonett suggests that a single supernova would produce two or three shock waves, an initial forward shock and a pair of reverse shocks from the initial expansion and a reflected wave from the shell boundary of a more ancient supernova.[39,40] Figure 2 shows that each episode in a series produced a similar amount of atmospheric radiocarbon. The sun lies almost exactly in the center[41] of the Local Bubble, believed to be the result of a past nearby supernova event. A candidate for the reverse shock wave is the supernova remnant North Polar Spur, with an estimated age of 75,000 years and a distance of 130 ± 75 parsecs (424 light years),[42] conveniently located in the north sky from where it would have preferentially irradiated the Northern Hemisphere. Assuming the Taylor flux is average and 1,000 neutrons are produced per erg of gamma-ray energy,[43] the catastrophe would have released about 10^{16} erg/cm^2 (2×10^8 cal/cm^2), corresponding to a solar flare of 10^{43} ergs or a gamma-flash of 10^{54} ergs from a supernova about 1 parsec away.

The geographical distribution of particle tracks, ^{235}U depletion, and ^{239}Pu concentration shown in Figure 3 are quite consistent, although the particle tracks seem to be confined to a smaller geographic area. They indicate energy released over the northeastern sector of the U.S., with maximum energy at about 43°N, 85°W, the Michigan area of the Great Lakes region.

A History of Suspected Cosmic Cataclysms Over the Ages

Wdowczyk and Wolfendale[44] and Zook[36] propose, based on the existing record of solar flare intensities, that solar flares as large as 3×10^{38} ergs should be expected every 100,000 years. Clark *et al.* estimate that supernovas release 10^{47}-10^{50} ergs within 10 parsecs of Earth every 100 million years.[45] Brackenridge suggests that a supernova impacted the earth in Paleoindian times.[16] Damon *et al.* report evidence from the ^{14}C tree ring record that SN1006, which occurred at a distance of 1300 parsecs, produced a neutron shower of 2×10^8 n/cm^2.[47] Castagnoli *et al.* report evidence of the past six nearby supernovae from the thermoluminescence record of Tyrrhenian sea sediment.[48] Dar *et al.* suggest that a cosmic ray jet within 1000 parsec would produce 10^{12} muons/cm^2 (greater than 3×10^9 eV) and 10^{10} protons and neutrons/cm^2 (greater than 10^6 eV) and deposit over 10^{12} erg/cm^2 in the atmosphere every 100 million years.[49] A cosmic ray jet is also predicted to produce heavy elements via the r-process and could be a source of ^{235}U enriched up to 60% in uranium.

The Paleoindian catastrophe was large by standards of all suspected cosmic occurrences. Normal geomagnetic conditions would focus cosmic rays towards the magnetic poles, concentrating their severity in those regions. However, low magnetic field intensity during a geomagnetic excursion may have allowed excessive cosmic rays to strike northeastern North America. (Whether the geomagnetic excursion admitted cosmic radiation, or the radiation caused the excursion, is uncertain. Given our present state of knowledge, cause and effect in this instance are unclear.) The presence of a nearby small and dense interstellar cloud may explain the origin of the particle bombardment.[50] The size of the initial catastrophe may be too large for a solar flare, but a sufficiently powerful nearby supernova or cosmic ray jet could account for it. It appears that the catastrophe initiated a sequence of events that may have included solar flares, impacts, and secondary cosmic ray bombardments.

A Devastating Effect on Earth

The enormous energy released by the catastrophe at 12,500 yr B.P. could have heated the atmosphere to over 1000°C over Michigan, and the neutron flux at more northern locations would have melted considerable glacial ice. Radiation effects on plants and animals exposed to the cosmic rays would have been lethal, comparable to being irradiated in a 5-megawatt reactor more than 100 seconds.

The overall pattern of the catastrophe matches the pattern of mass extinction before Holocene times. The Western Hemisphere was more affected than the Eastern, North America more than South America, and eastern North America more than western North America.[51,52,53] Extinction in the Great Lakes area was more rapid and pronounced than elsewhere. Larger animals were more

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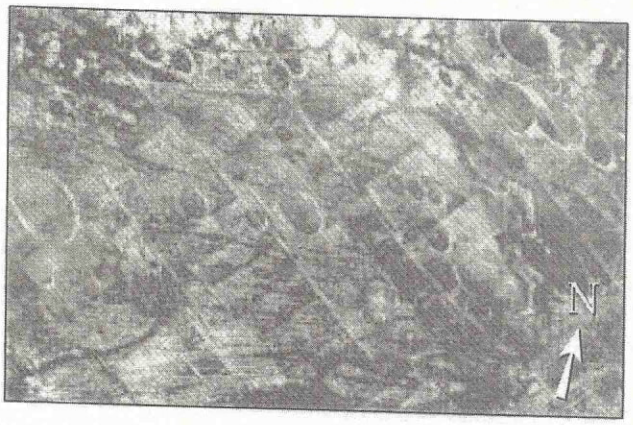

A shock wave of the magnitude that would be expected from a supernova may have gouged out the Carolina bays, 500,000 depressions spread over an area of 100,000 square miles on the Atlantic coast from North Carolina to Florida. First noted in aerial photographs in the 1930s, they date to Paleoindian or late glacial times.[37,38] At least 16 hypotheses involving terrestrial and extra-terrestrial causes have been postulated to explain their origin. In this mosaic of 1930s aerial photos shot in the vicinity of Myrtle Beach, S.C., the large depression at extreme left measures about a mile along its major axis. It is noteworthy that the elliptical depressions are all oriented with their major axes pointing towards the Great Lakes region.

From *The Origin of the Carolina Bays,* by Douglas Johnson. © 1942 Columbia University Press. Reprinted by permission of the publisher.

affected than smaller ones, a pattern that conforms to the expectation that radiation exposure affects large bodies more than smaller ones.[54,55] Sharp fluctuations of ^{14}C in the Icelandic marine sediments at each geomagnetic excursion are interesting; because global carbon deposits in the ocean sediments at a rate of only about 0.0005% a year, a sudden increase in sediment ^{14}C may reflect the rapid die-off of organisms that incorporated radiocarbon shortly after bombardment.

Massive radiation would be expected to cause major mutations in plant life. Maize probably evolved by macro-mutation at that time,[55,56] and plant domestication of possibly mutated forms appears worldwide after the Late Glacial period. For example, there was a rapid transition from wild to domesticated grains in the Near East after the catastrophe.[57]

Implications for Future Study

Much of what we assume about the Paleoindian period and the peopling of the Americas has been inferred from conventional radiocarbon chronology, which often conflicts with archaeological evidence. This work mandates that conventional radiocarbon dates be reinterpreted in light of hard terrestrial evidence of exposure of the radiocarbon samples to a cosmological catastrophe that affected vast areas of North America and beyond. A nuclear catastrophe can reset a group of unrelated artifacts to a common younger date, creating gaps and false episodes in the fossil record. Geographical variation and complicated overburdens may further confuse the interpretation. Scrutiny of Paleoindian artifacts and the North American paleolandscape, associated stratigraphic sediments, coupled with continued radiological investigations, may provide more evidence for the cosmic catastrophe and new clues to the origin of Paleoindians.

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Evidence of Planetary Artifacts

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3-D contours, bilateral symmetry, plus location and upright orientation on the former Martian equator led to suspicions that the so-called "Face" mesa in the Cydonia region of Mars might be an artifact. A new high-resolution image taken by the Mars Global Surveyor (MGS) spacecraft initially appeared to refute the artificiality hypothesis. However, the low viewing angle, unfavorable lighting, and limited grayscale range of the new image made even the features seen earlier unrecognizable at first. Once the image was properly processed, the previous features located, and the distortions removed, the new image shows the fulfillment of *a priori* predictions of secondary facial characteristics not previously seen (eyebrow, iris, nostrils, lips), despite the extreme improbability of each of these existing with the correct relative size, shape, location, and orientation. When combined with the lack of similar background features, these meet the necessary and sufficient criteria to strongly disfavor the natural origin hypothesis. Other anomalous objects and surface markings in the vicinity reinforce this conclusion. A methodical high-resolution photographic survey of the Cydonia region, while that is still possible, is surely warranted.

In science, it is axiomatic that "extraordinary hypotheses require extraordinary evidence." This is not a precept, but an observation about the progress of scientific knowledge. Evidence that refines or extends knowledge in a way that is consistent with accepted beliefs is rarely scrutinized to dispel skepticism about its validity, since there is ordinarily no cause for such skepticism. In contrast, evidence that suggests contradiction to existing beliefs will be viewed with a degree of skepticism proportional to the cost of accepting such evidence. That cost, both psychological and economic, of changing direction, *i.e.,* of discarding widely held beliefs, is too great to be accepted without the overwhelming pressure of evidence

Figure 1. "Face" and "City" at Cydonia on Mars. Excerpt from Viking frame 35A72 of July 25, 1976.

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that cannot be credibly disputed. Thus, evidence that would necessitate such a change of beliefs is, and must be, subjected to a level of scrutiny that would be inappropriate (cost-ineffective; unjustifiably tedious) if applied to evidence consistent with accepted theory. Evidence that survives this extraordinary scrutiny is extraordinary evidence.

Here we will apply the *a priori* principle. *A posteriori* findings are of unknown or ambiguous significance almost regardless of their probability of occurrence. By contrast, the probability of occurrence of *a priori* predictions is as significant as that probability allows. When hypothesis-distinguishing *a priori* predictions are fulfilled at a level where chance is an unlikely explanation, we normally conclude that the hypotheses are in fact distinguished by the data. In most applications, this principle is invoked to deny statistical significance to *a posteriori* findings that might appear highly unlikely to arise by chance.[1] This is because (like winning a lottery) the probabilities are only low for predicting a specific outcome (the particular winning ticket holder) before the results are known, but are generally not low for some unusual or surprising outcome (*e.g.*, the view of the winner after the results are announced). Therefore, when many improbable outcomes are possible, no special significance may ordinarily be attached to some of them happening. Here we show a finding that robustly survives this principle's application because the occurrences were both the fulfillment of *a priori* predictions and of extraordinarily low probability to arise by chance.

In 1976, the Viking 1 and 2 spacecraft photographed much of Mars at a medium resolution of about 50 m. per pixel. In 1977, Vincent DiPietro and Gregory Molenaar found a second of two similar pictures of the so-called "Face" on Mars in the region named Cydonia at west longitude 10°, north latitude 41° (the first one shown in Figure 1 was found by Tobias Owen). The resemblance of the object's sunlit portion to a humanoid face has aroused widespread attention from both scientists and tabloids. However, the number of random shapes formed by structures on moon and planet surfaces is so vast that no statistical significance can be attached to any such finding because of its *a posteriori* nature. Chance "faces" can and do arise in clouds and on landscapes.

Nonetheless, based mainly upon the non-natural appearance of this object and several of its immediate neighbors, two opposing hypotheses were immediately formulated: (1) the object is an artificial structure built by an extraterrestrial intelligence; (2) the object is a natural structure having a face-like appearance produced by tricks of light and shadow. Among the eight tests[2,3] originally conceived to distinguish the two hypotheses were these:

1. Known large-scale objects resembling faces by chance are either two-dimensional albedo-variation features or 2-D profiles. Photoclinometric views of the "Face" on Mars in the two medium resolution photos showed that the eye socket, nose, and mouth features had roughly the correct three-dimensional relief. Moreover, the object still showed these same basic facial features in six other low-resolution photos taken from a variety of other Sun angles. This argued against a trick of light and shadow, and suggested artificiality.[4,5] The only other known mountain-sized 3-D faces in the solar system are on Mount Rushmore.

2. Only half a face (the west side) was seen in the two original medium-resolution photos. The *a priori* chances were negligible that an even crudely mirror-symmetric half face would exist in the unseen shadow of this mesa. Very conservatively, planetary scientists have examined 10^4 features of comparable size in surface photos of the Moon, Mercury, Venus, and other planetary satellites without seeing any other such strikingly face-like formations. Based on this, the odds against any feature in the shadow of the visible half-face mesa having a mirrored-half-face-like shape so as to produce the appearance of bilateral symmetry by accident are at least 10^4 to 1. Even if the correct shape existed, the odds are still against it having the correct orientation (eye opposite eye, continuation of lips, etc.) to match the shape seen. Allowing a 30-degree orientation range for a successful match of the two half-faces (seen and unseen), the odds against that happening by chance are roughly an additional factor of 12 to 1. For some time after the two original Viking "Face" images were found, the image processing techniques for applying this test were unavailable to investigators.[6]

3. If the "Face" were built, it can only be seen as a face from above, but not from Martian ground level. So a culturally significant location (for an intelligent, presumably space-faring species) such as on the equator would suggest artificiality. Moreover, if the "Face" were intended to represent a face, it would surely have been built with the axis of symmetry (bisecting the "eyes" and "mouth" features) having a north-south orientation so that the face could be recognized as such. Neither condition was apparently met by the present mesa at Cydonia [40.89°N latitude, axis of symmetry orientation 20.5° W of N], suggesting a natural origin.

Image enhancement is a process, much like focusing, that alters an image from the way a camera lens sees it to the way the human eye would have seen it; for example, by modifying brightness or contrast. When properly applied only to broad areas with similar illuminations, it cannot introduce distinct shapes where none exist in the original scene. Both DiPietro[7] and Carlotto[2] developed image enhancement techniques that continued to improve until enough detail could be brought out in the shadowed east side of the "Face" mesa. Figure 2 starts

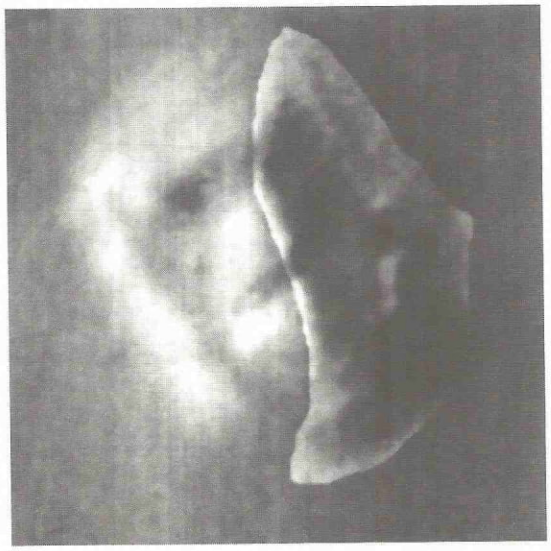

Figure 2. "Face" with dark side detail. Dual contrast-stretched view from Viking frame 70A13 shows detail simultaneously on both sunlit and shadowed sides, suggesting significant bilateral symmetry.

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with Carlotto's technique, then isolates the shadowed portion as outlined, and applies brightness and contrast adjustments separately for that portion. The result apparently bears a passable resemblance to a mirror half-face. An east eye socket appears to exist, the mouth feature goes through, and the "headdress" or enclosure for the mesa goes completely around except perhaps in the southeast corner. Therefore, the bilateral symmetry test for artificiality was apparently passed despite *a priori* odds of at least 10^5 to 1 against that (face-like and bilaterally symmetry) happening by chance.

Van Flandern[3] recently found that the "Face" [40.89°N, 9.52°W] was both located on the equator and oriented upright with respect to the most prominent long-term former location of the Martian geographic pole as determined by Schultz [45°N, 160°W][8], to a computational precision of better than one degree in each angle. This precision is assumed somewhat fortuitous, given that the old pole location was only specified to the nearest 5° in each coordinate (*i.e.*, with a mean error of ±1.7°). Nonetheless, this finding apparently reversed the results of the cultural significance tests in favor of artificiality at better than the 99% confidence level. Combined with the bilateral symmetry test, the odds against a chance natural origin were then 10^7 to 1. Van Flandern[3] makes an argument that the last sudden pole shift on Mars may have occurred 3.2 million years ago, suggesting that the "Face" mesa is at least that old.

The tendency of the results of all known objective tests to favor an artificial origin has resulted in the publication of several books on the Cydonia region in general, and the "Face" object in particular. Among those, four written by professionals are especially relevant.[2,7,9,10] Additionally, two peer-reviewed papers on anomalous placements of mound-like features in regions near the "Face" are relevant.[11,12]

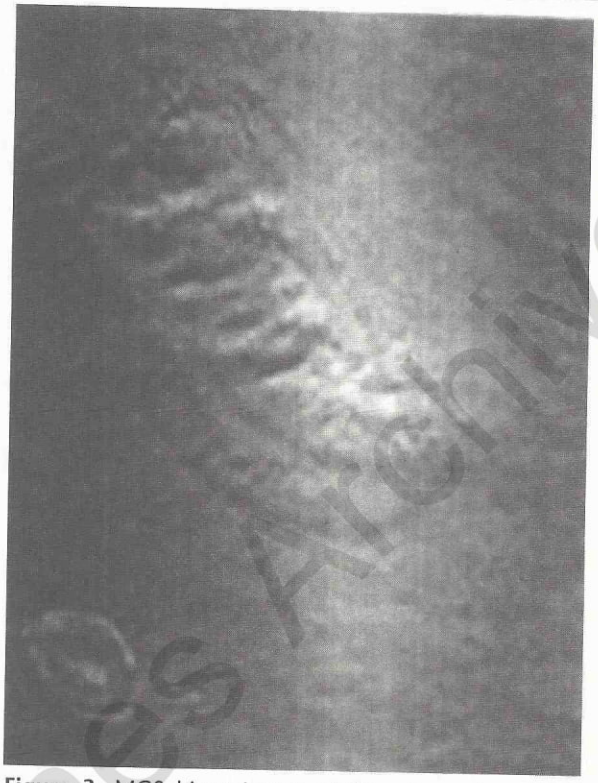

Figure 3. MGS hi-res image of "Face" as released to media. Taken from an April 5, 1998 strip image over the Cydonia region. High-pass filter virtually eliminated mesa surface features so that even details already seen in all Viking images could not be recognized.

New MGS Images of "Face" Mesa

Cognizant of this and other information, on March 26, 1998 NASA announced in a press release that the Cydonia region would be one of the prime targets during the month of April 1998 for the MGS spacecraft. Its high-resolution camera is capable of nearly 1-meter resolution if pointed straight down from normal orbital altitude. On April 5, a high-resolution strip photograph roughly 4 km. wide and 44 km. long captured the 1.5-km. wide "Face" mesa from a slant range of about 430 km. The resolution achieved was roughly 5 m. per pixel—half the resolution capability of the camera at that range. The grayscale range was heavily restricted, with most of the visible side of the Face mesa represented by just four grayscale levels out of a possible 256.

The following day, the raw strip image was retrieved and posted to the Internet,[13] and a processed extract of the "Face" mesa alone was released to the media by the Jet Propulsion Laboratory's (JPL) Mission Image Processing Lab (Figure 3). It has come to be known as the "footprint" image because the high shadow-producing central facial features seen in Figure 1 appear smashed as by a giant foot. The reason is that it utilizes even fewer grayscale levels than the raw data, making features virtually invisible from lack of contrast. This is apparently the consequence of the use of excessive high-pass filtering of the image.[13] Moreover, JPL provided no information about the unfavorable viewing and lighting conditions under which the image was acquired. The 45-degree emission angle (tilt of the camera line of sight from the vertical) allowed only a bit more than half of the western side of the "Face" mesa to be seen clearly. The eastern side was hidden by shadow in the highest-resolution Viking images of the "Face." The sun was to the southeast of the Face mesa, so if this landform is actually a representation of a face, it was illuminated from under its "chin." Such a lighting geometry can radically distort the appearance of an actual human face.

Even with proper image processing, an artist's sculpture crafted to look like the face from the Viking image was not recognizable as such under MGS viewing and lighting conditions (Figure 4).[14]

Figure 5 shows the MGS image of the "Face" mesa with normal image processing, but stretched in the direction of the camera line of sight to compensate for foreshortening caused by the camera's 45-degree emission angle. This stretching operation gives a better view of the foreshortened features on the eastern side of the landform, but does not show a true picture of what the landform would look like if viewed from directly overhead. The eastern and western portions of the landform were separately processed so details in both would be comparably visible. No filters were used. The inset shows the same view with brightness and contrast optimized for the near (west) side only, and marks the apparent facial features seen, starting with those previously identified in Viking imagery. That the height of the "nose ridge" is greater than anything on the west side of the "Face" mesa can be ascertained by parallax between Viking and MGS images. This implies that some of the east half of the "Face" will be hidden behind the "nose ridge."

Figure 6 shows the MGS image of the "Face" mesa with advanced image processing to correct the lighting and

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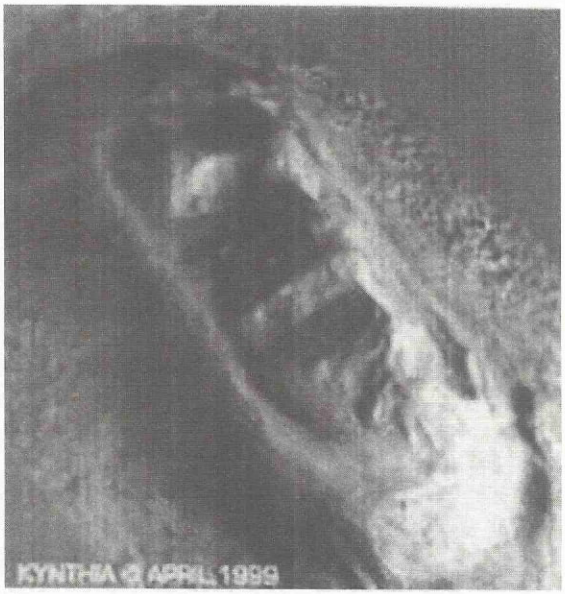

Figure 4. Sculpted face by Kynthia. When viewed with-MGS perspective and illumination, it is no longer recognizable as a face.

viewing angle to match Viking conditions (Sun in WNW, spacecraft overhead). The correspondence between the Viking and MGS images is now obvious. An animation showing this transition in steps is available on the web.[15]

The most visually striking characteristic of the mesa is the almost perfect symmetry and regularity of the mesa enclosure. It is perhaps 200 m. high (about half the maximum height of the mesa), with linear top and linear sides forming right angles, and a smoothly rounded bottom. Carlotto's stereo pair (Figure 7) was created from the MGS image with the assistance of photoclinometry from the Viking image. This allows a view of how genuinely anomalous this mesa is in three dimensions, and how out of context it is against its flat, featureless desert surroundings. Image rectification by Carlotto[16] confirms that the "nose ridge" is in fact centered on the axis of potential symmetry of the mesa to within 2%. Although we do not include any of these symmetries in our statistics because of their partially *a posteriori* nature, they are examples of how the mesa displays less randomness at high resolution than it did at low resolution.

If and only if the mesa was constructed to portray a humanoid face, secondary facial characteristics not seen in the Viking photos would be expected in the MGS image. The most conspicuous of these is the shallow triangular prism-shape seen clearly in the original MGS image despite low contrast,[13] located directly over the west eye socket (Figure 8). It is striking to find a triangle with three such joined linear sides ending in vertices in any natural object. But this object has a shape that yields the impression of a furrowed eyebrow. The best-known example of a triangular-shaped feature elsewhere in the solar system is the roughly equilateral-triangle-shaped interior of the Ukert crater near the center of the Moon's visible disk. But in that case, higher resolution Clementine images showed irregular sides and rounded apexes, as expected for a natural feature. Using the same basis as earlier for face-like shapes, we conservatively estimate the probability of an object with such a good triangle shape appearing anywhere on this mesa at 10^{-4}. Other

Figure 5. MGS hi-res image of "Face," properly processed. View is from a moderately low angle to the west, illuminated from a low Sun toward the SSE. Dual contrast-stretched to make details for both sunlit/foreshortened (east) and ambient-light/perspective-stretched (west) sides of mesa comparable in brightness. Inset has apparent facial features marked for easier identification.

Figure 6. MGS hi-res image of "Face," computer-processed to correct lighting from SE to NW and viewing angle from 45° W to overhead—conditions similar to those encountered by the Viking spacecraft in 1976. This is the product of three image-processing professionals, M. Kelly <www.electrobus.com>, M.J. Carlotto <www.psrw.com/~markc/Articles>, and B. Starosta <www.starosta.com>.

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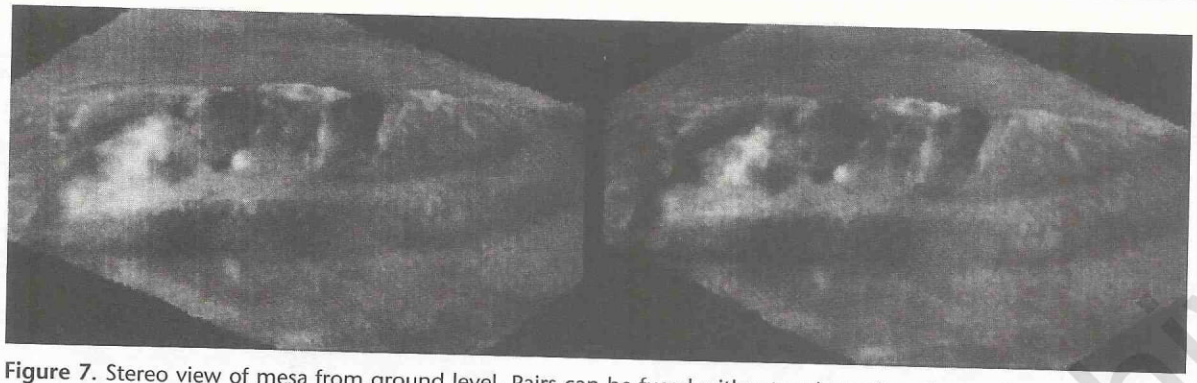

Figure 7. Stereo view of mesa from ground level. Pairs can be fused without a viewer by relaxing the eyes until they are focused at infinity. This creates four images from the two on the page, one pair for each eye. When the middle pair of images are overlapped, the image should pop out in three dimensions. The symmetry and regularity of the enclosure, and the contrast with its surroundings, become particularly evident in this Carlotto recreation based on Viking and MGS imagery combined.

probabilities are applicable to its specific location within the mesa, relative size, and orientation (see Table 1). Not only is each of these probabilities *a priori*, but there is no background of similar objects from which we can choose just ones that fit our concept of an eyebrow on a face.

Additional secondary facial features make their first appearance in the MGS imagery. In the "eye socket," at the lower center, we see a circular feature resembling an iris (Figure 9). The end of the "nose ridge" contains two roundish impressions suggestive of nostrils (Figure 10) about as closely as one could expect, given so few grayscale levels in this part of the image. Moreover, the ridge appears to narrow as it approaches the forehead, just as a nose does on a real humanoid face. There is even a possible representation of the facial septum joining nose to upper lip, where the "mouth" feature appears to curl upward slightly as on a real face. And the mouth feature appears to have parted lips, another feature widely unrecognized in Viking imagery. The depth of the eye socket and the "ravine" between the parted "lips" ensure that shadows at virtually any Sun angle will create the visual impression of an eye and a mouth, just as they did in the photos. The combined odds against all the "coincidences" in the table arising by chance are 10^{19} to 1. In combination with our earlier odds, the overall probability of a natural origin is 10^{-26}. This easily covers even the extra-conservative criteria for judging the realistic significance of anomalous phenomena recently advocated.[17]

The keys to the validity of this statistical argument are that 1) the secondary facial features exist; 2) there is no background of comparable objects to choose from; and 3) they are predicted *a priori* by the artificiality hypothesis. Image processing experts (*e.g.*, Carlotto, DiPietro) agree the features seen, although of low contrast (because the original image had so few grayscale levels), are not artifacts of image processing. And any one of the secondary facial features by itself provides a test sufficient to disfavor a natural origin for the mesa. The lack of background confusion of a similar character to these features is evident by inspection. To be an *a priori* hypothesis, no one

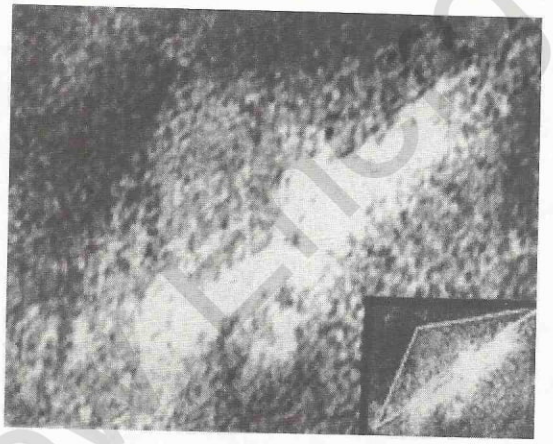

Figure 8. Close-up of "eyebrow" feature. Despite low contrast, two linear sides can be traced in the "eyebrow," and a third connecting them can then be traced just above the white, brightly sunlit surface. (Refer to inset.) This latter shiny surface faces toward the Sun low in the SSE, and therefore is roughly perpendicular to the triangular top, apparently on the front side of the "eyebrow" block.

Table 1. SECONDARY FACIAL-FEATURE PROBABILITIES

Feature	locn	size	shape	orient	bkgnd
Eyebrow over Eye	1/35	(27-10)/54	1/10,000	30/360	No
Iris in Eye Socket	1/23	(12-2)/54	1	1	No
Nostrils on Nose	1/80	(9-2)/54	1	30/180	No
Lips on Mouth	1/62	(28-12)/54	1/1,000	30/180	No

Column definitions –

Location: ratio of the area in which the center of the feature could be located to be considered a secondary facial feature portrayal, to the area of the whole Face mesa.

Size: ratio of the difference between the maximum and minimum width for a feature to be considered a secondary facial feature, to the width of the mesa.

Shape: maximum ratio of the number of occurrences of the particular shape used to portray the specific secondary facial feature on other moon or planet surfaces, to the total number of features of all shapes.

Orientation: ratio of the range in degrees for the feature to be considered as a secondary facial feature portrayal, to the applicable maximum number of degrees possible.

Background: Does the feature fall outside the specified range for any attribute, or do similar features appear anywhere else on the mesa?

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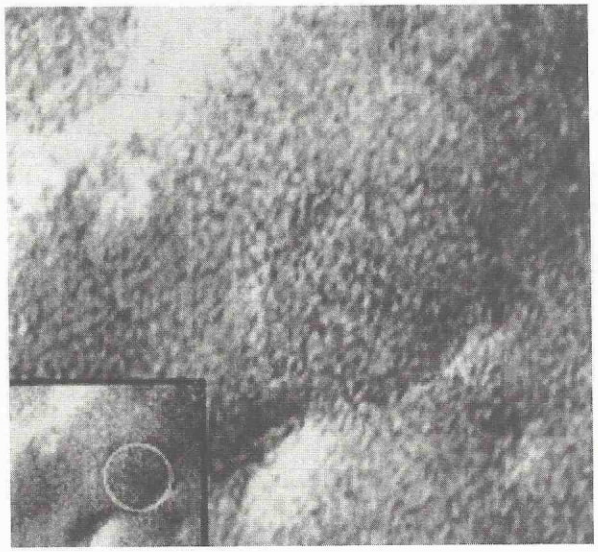

Figure 9. Close-up of "iris" feature within "eye-socket." Circular feature at bottom center of "eye-socket" resembles an iris. (Refer to inset.) Both "eyebrow" and "iris" features have roughly the right size and shape, and are in the correct position with the correct orientation, to be a deliberate attempt to portray facial attributes. Except for the iris (a circle) no background of comparable objects exists from which the mind can select ones fitting a face model by chance.

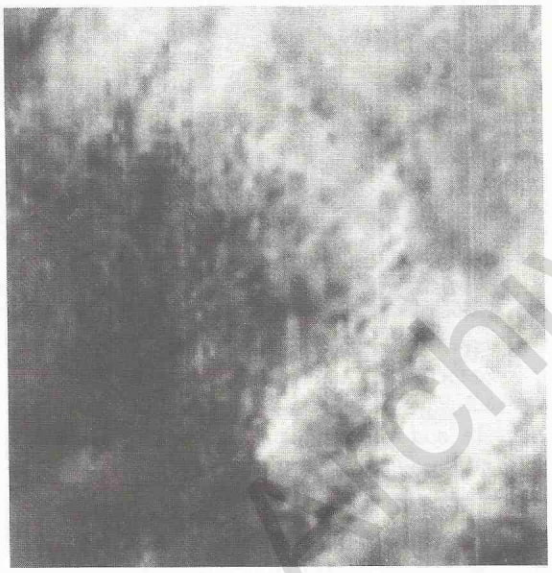

Figure 10. Close-up of "nose ridge" feature. Shows narrowing of "nose" toward the forehead, as on a real face. Roundish features at the end of the eroded "nose" appear to portray nostrils, despite minimal available grayscale levels. No similar features appear elsewhere on the mesa. Yet these have the correct size, shape, location, and orientation to be deliberate.

needs to state it in print; general agreement that the competing hypotheses do have the stated implications is sufficient. Then the statistical argument can be seen as analogous to being dealt a bridge hand of thirteen spades. After the fact, that hand is just as probable as being dealt any other specific hand. But naming the exact hand in advance of being dealt is so improbable as to merit the conclusion that something extraordinary has occurred. And the same can be said for the appearance of secondary facial features having the right size, shape, location, and orientation on a mesa suspected on other grounds of being a "Face"-portrayal artifact.

Some of these features are inconspicuous when not illuminated by direct sunlight, as in the MGS image. No doubt, erosion and wind-blown sand have taken their toll. And they may have been intended for daytime-only viewing. However, if the mesa is artificial, then artificial lighting from the mesa enclosure might have produced similar effects at nighttime, increasing the contrast for easy viewing from above. But it suffices for hypothesis testing that these features exist, whether or not conspicuous. Many other *a posteriori* features of the mesa also do not appear random, but decorative, as for a face in costume. Especially noteworthy are the linear features in the "helmet" just above the enclosure top, the symmetric "crest" in the sand just above the "helmet," the linear markings on the "cheek" and "chin," and the apparent L-shaped right angles in the upper left and right corners of the mesa enclosure.[3] Allowing for some erosion, especially on the nose ridge that sticks above the protection of the enclosure, one can picture that everything about this mesa might be part of a planned design. Of course, none of these *a posteriori* points influenced our probability calculation.

Additional Anomalies

The "Face" mesa is not the only feature difficult to explain as a natural formation. In the April 23 MGS image of the "City" area of Cydonia just west of the "Face" mesa, we can see a set of imbedded triangles (Figure 11). Two or perhaps three additional, roughly equi-spaced bases can be faintly traced to the upper right of the most conspicuous triangle. Numerous other features of high regularity, symmetry, and/or angularity also appear in all three MGS images of the Cydonia area, including many more examples of triangle shapes. The "Face" mesa is far from being an isolated singularity, since many nearby objects also have attributes suggesting artificiality.

Among the most difficult of all of these to explain by natural processes are the "anomalous surface markings" (Figure 12, noise-filtered in Figure 13). The largest of these are about 50-60 m. tall, 30-40 m. wide, and are blacker than any other feature in their immediate vicinity. They are located behind the so-called "D&M Pyramid" near the center bottom in the April 5 image, just above a bright "V"-shaped feature that dominates the area. These are fully integrated into the brightness and background noise levels for the image, precluding some sort of accidental superposition in a terrestrial laboratory. Besides, MGS Imaging Team Principal Investigator Michael Malin represents that the image was decoded from bits and converted to Internet-viewable formats entirely inside computers,

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New "Face" Image Reveals More Detail

The latest MGS spacecraft image of the Cydonia "Face" on Mars, taken on April 8, 2001 and released on May 24 (since the accompanying article was completed), contains a view showing the east side of the "Face" in more detail. Analyses of this image by two of these same authors are now available. The first is by Lan Fleming at http://www.vgl.org/vglmars.htm. The other contains my own analysis published in the June 15, 2001 Meta Research Bulletin and also available at http://metaresearch.org/solar%20system/cydonia/2001_Face/Preliminary.htm. In essence, this latter article first finds that the east-side iris and eyebrow features, for which no information existed in the previous shots, are not only present, but lie essentially on top of their west-side counterparts when the "Face" image is folded about its axis of symmetry down the "nose" ridge. This completes the proof of artificiality based on the a priori principle—using only those elements that provide legitimate statistics under the rules of scientific method. The criteria of "looking like a face" or not looking like one are not among the legitimate criteria because our human biases too easily predispose us to see faces where there are none, and to fail to see them even where they exist. That said, it must be acknowledged that the new image looks mildly less face-like than previous views that emphasized the west side. However, closer inspection reveals a circular impact crater in the southeast portion of the mesa that apparently produced a melt-outflow feature displacing and filling in part of the east-side "mouth" and "eye socket." But for this obscuration, the possibility exists that the two sides would have mirror-perfect symmetry. Additionally, everyone interested in this topic should examine the "Artificial Structures on Mars" link under "Current News" at http://metaresearch.org, which shows about forty of the most puzzling anomalies seen so far on Mars that tend to support the hypothesis of past activity on Mars by large-scale, probably intelligent life.

Tom Van Flandern / Meta Research

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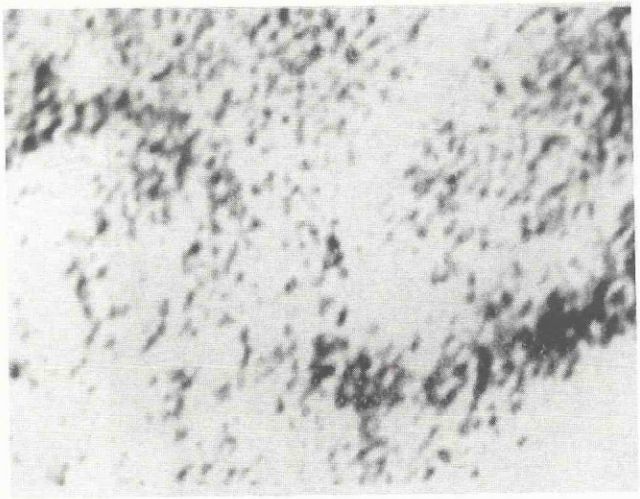

Figure 13. Extract from previous figure with standard noise filter applied to eliminate noisy or random background from image.

the process witnessed by reporters, in the span of less than an hour before the image (still downloadable today[11]) was posted to the Internet and accessed by some of the present authors, among thousands of others. Resembling simple symbols made of lines and curves common to many terrestrial languages, including a horizontal symbol-string arrangement with an occasional taller symbol on the left, these would certainly be regarded as having a human origin if found on Earth.

Discussion

Scientific method teaches us to distinguish *a priori* and *a posteriori* statistical arguments to avoid self-deception, both from falsely attaching significance to chance occurrences, and from failing to attach significance to genuine anomalies. Conservatively estimated, the combined probability of simultaneous chance occurrence of all the features of the "Face" mesa alone described in this article and predicted *a priori* by the artificiality hypothesis is 10^{-26}. On that basis, we logically ought to rule out a natural origin for what we see of this mesa. Of course, we have not attempted to estimate the very small probabilities for competing hypotheses such as someone faking or altering the images before they were placed on the Internet. The most reasonable interpretation (in the sense of Occam's Razor) is that the mesa was built by intelligent beings, because that hypothesis requires no changes to known physical laws and no vast, apparently motiveless conspiracies. When additional artificiality indicators seen throughout the Cydonia region are also considered, we suggest that "extraordinary evidence" of the Cydonia artificiality hypothesis now exists at a level that makes it highly competitive with any alternative hypothesis.

Although Levin[18] has now concluded that the Viking Labeled Release experiment did in fact detect living microorganisms in the soil of Mars, most astronomers and astrobiologists recognize the improbability of an intelligent species native to Mars. However, that does not affect the likelihood of interplanetary visitors, whose origins and motives we cannot know. The short technological history of our own species strongly suggests that when a species demonstrates the ability to design and build megalithic monuments, the probability that it will not also develop space travel is likely to be small. With the limited knowledge in hand it would be useless to speculate, and imprudent to make speculative assumptions, about the origins of such visitors. The same may be said about the implications of the portrayal of a humanoid face, which may resemble either the builders or the intended viewers, or both.

We can only say with assurance that here is a scientific puzzle of great import. We urge that the highest priority be attached to obtaining additional images of the entire Cydonia region at the highest available resolution. This seems the only way to resolve our mystery with any confidence. In particular, re-imaging the "Face," embedded triangles, and anomalous surface markings from overhead, under better lighting conditions, with better resolution and contrast, should confirm the existence of the features discussed here and assure everyone they are not the result of tampering or amazing statistical flukes. In our estimation, enough evidence now exists to justify interrupting or extending the MGS mission until the entire Cydonia area can be mapped at high resolution.

Acknowledgements

The "anomalous surface markings" in Figure 12 and 13 were discovered by geologist Harry Moore shortly after the image was first released. We thank the following discussants for their specific advice and critiques: Peter Espenschied, Ralph Greenberg, Yoji Kondo, Conley Powell, Tim Seward, Ananda Sirisena, Joe Sitter, James Strange, and members of the Society for Planetary SETI Research (SPSR). We also thank Mark Kelly and Boris Starosta for their image processing expertise, and Kynthia for her sculpture.

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New Energy Companies and Inventors

Status Reports on Technologies and Claims

This is a continuing series of updates on the activities and achievements of new energy companies, organizations, and inventors.

Cook Inertial Propulsion (CIP) Engine

Robert Cook, 4429 Holly Street, Guadalupe, CA 93434

Infinite Energy has previously featured a progress report on the testing of Robert Cook's "inertial propulsion" (CIP) engine at Boeing (see *IE* Nos. 28, 29). In mid-October 2001, we received the following update from Mr. Cook, in which he mentions a test that he personally conducted. Details are sketchy; we hope that he will be able to submit a more comprehensive report in the future:

"For several months I have been trying to perfect the performance of the CIP engine so that a conclusive test could be performed. This has proved to be a nightmare of the worst kind imaginable. But all problems have finally been solved and a perfectly reliable machine has been tested.

"Tests on the Cavendish Torsion Pendulum have already resulted in 4 to 5 inches positive displacement of the 'center of mass' of the machine in spite of dire predictions from top experts. This motion was the result of 3 impulses. The next test will entail 6 impulses and over 1 foot movement is anticipated as a result. The results of this testing show that a TRUE reactionless drive has been successfully proven. This should come as good news to the average consumer because it means the age of the practical electric car will soon be here and the end of the gas hog is ensured. Proper funding will determine how soon the CIP engine will be in wide use around the world."

DW Research, LLC

1350 Northface Court, Colorado Springs, CO 80919
Phone: 719-598-1426 (David Wallman)

On October 21, 2001, we received an encouraging letter from DW Research, a company that was featured in a previous update (*IE* No. 38). In part:

"I thought you might like a brief update as to where our project stands in production rate and efficiency, along with some pertinent data we have about Carbo-hydrogen gas.

- Gas production rate: 12 cubic feet/kilowatt-hour @ 25vDC and 60 amps, 5 psi (DW Energy)
- Energy content of gas: 550 btu/cubic foot (DW Energy)
- Production ratio of gas versus water used: 1866 to 1 (William Rhodes, Ph.D)
- Air to Fuel ratio for optimum combustion: 5:1 (Solar Energy Research Inst)
- Octane rating: 150 to 200 (SERI)
- Optimum compression ratio: 13.5:1 - 15:1 (SERI)

"In other news, I will be a speaker at the World Congress on a Hydrogen Economy in Denver, Colorado sometime in 2002. The event was postponed from November 2001 because of the attacks in New York City and Washington, D.C. It is supposed to include Dick Cheney, Christie Todd Whitman, and various state governors, and policy makers. Information will be available at www.hydrogennow.org."

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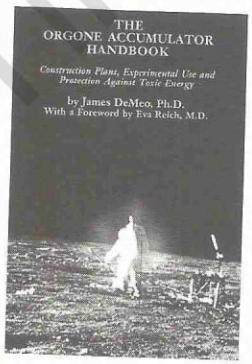

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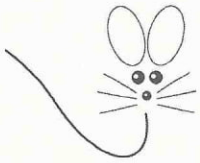
The FUTURE of ENERGY Essay Contest Winners

Cold Fusion, Nanotechnology, and *The Mouse That Roared*



C.C. Douglas*

While gathering resource material for this essay, I came across a couple of books I had read as a kid that you might find interesting and, at the same time, provided me with an admittedly whimsical foundation for that which is to follow. *The Mouse That Roared* and its sequel, *The Mouse on the Moon,* written in the late 1950s and early 1960s by Leonard Wibberley, satirize the inefficacies of big government and big science. While Wibberley aims much of his work at younger audiences (after all, political satirists do use cartoons for we simple minded voters), these stories should serve well for readers of all ages. In *The Mouse That Roared,* Wibberley tells the story of a small principality, the Duchy of Grand Fenwick, which, in order to avoid an impending fiscal catastrophe brought on by an incredibly bad wine crop (the Duchy's main export), decides to declare war on the United States. Intending to lose quickly and thereby qualify for copious reconstruction funds from the U.S., the small expeditionary force, comprised of a handful of bowmen armed with blunt arrows, nearly wins the war. The mega-military power of the United States, it seems, was simply not prepared to deal with such a minor contingency.

The sequel, *The Mouse on the Moon,* continues the saga with the Duchy's chief winemaker, a Professor Kokintz, utilizing a donated American surplus Atlas booster stage initially intended for use as a boiler for the castle's new hot water system, to build a workable space vehicle. As luck would have it, the season's exceptionally poor wine has unusual properties that make it the ideal fuel for a low power, continuous acceleration, propulsion system. So, using shower heads as exhaust nozzles, and the Grand Pinot '59 as propellant, Grand Fenwick challenges the mighty NASA to a race to the moon and wins! It was while reading this book (at the age of twelve) that I realized, for the first time, that the 25,000 mile/hour in one burst escape velocity requirement I had accepted as doctrine was not the only scenario of breaking the bonds of Earth's gravity in order to accomplish a flight into space. (In fact, with a very small amount of power, applied continuously for as long as necessary, space flight can be accomplished, with a lot less risk to the occupants of the space craft, not to mention the reduction in environmental impact. I could fly such a ship out of my backyard, lifting off say at 10 mph, without so much as a blade of grass burned, then, once safely high enough, accelerate at a constant 1g, and reach the moon ten days later.) At any rate, both stories are witty. Wibberley is a funny guy, but his underlying message may not be. Complexity breeds vulnerability. Which brings me to the subject of this piece on energy and innovation.

Human beings like things simple. Governments and large corporations do not. It is their nemesis. Simplicity is raw power for the individual. Understanding how things work helps us to maintain control of our environment and our very lives. A knowledgeable citizenry is a threat to the mega-entity. My dreams of space exploration, and the dreams of generations before me, had little to do with the huge industrial complex required to achieve it. Most of us, more likely, connected philosophically with the guy tinkering in his garage, building a rocket and launching himself into space using a simple but elegant solution for a propulsion system. Perhaps that is why the space program, even the moon landings, left so many people disenchanted, driven to the brink of apathy. Perhaps people realized that the only participation they were afforded was the dubious privilege of footing the bill.

Regarding the field of nanotechnology, I've read the Feynman speech and most all of Drexler's two books, *Engines of Creation* and *Nanosystems*. I've read essays of narrow vision from critics of nanotech's possibilities, like Gary Stix of *Scientific American,* the arguably limiting sensibilities of Tom Craver, the painfully academic but fascinating extrapolations of Mark Krummennacker, the contagiously optimistic scenarios of Bill Spence, and the hopefully abundant quotes from the faithful. As an *Infinite Energy* enthusiast, you should read them as well. For one reason or another, there seems to be a large number of very bright people attracted to both the emerging sciences of nano and cold fusion. It feels good to think about the potential of these disciplines. And whether believer or non-believer, a central theme pervades. We *really need* these methodologies to arrive. Michael Faraday, the lynch-pin of our modern electrical civilization, said, "Nothing is too wonderful to be true." Please note, however, that I found this quote on his web page. . .which happened to be advertised as the official web page for *cold fusion.* In fact, the cold fusion "home page" was very reminiscent of many nanotech web pages. True believers constantly battling for credibility, pitting themselves against the prolific jaws of stodgy, narrow-thinking, ultra-conservative critics.

A friend of mine, who is an adamant disciple of nanotech, laughs at the idea of cold fusion. Nonetheless, cold fusion devotees claim that a lot of successful work is currently being done in the field. They list a myriad of institutions where this research is being done. Like the nanotech folk, they acknowledge Japan as the leader in this research, at least as far as capital investment is concerned, and even refer to the

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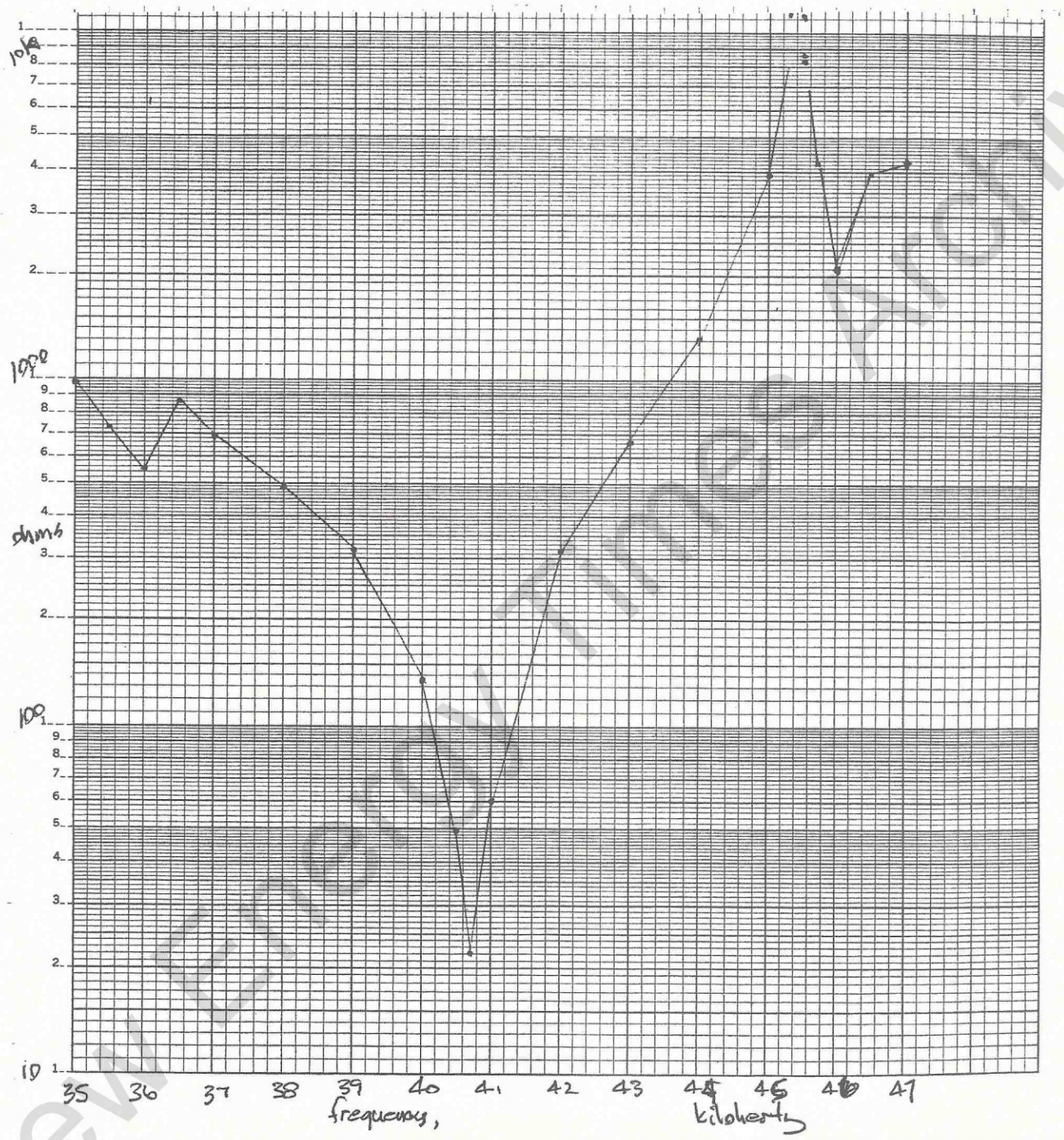

Figure 1. This is a plot of the measured electrical impedance (ohms) of a titanium mounted piezo stack manufactured by Crest Ultrasonics with a 5 mH coil in series. The impedance varies from 22 ohms to over 10,000 ohms from 35 kHz to 47 kHz.

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plasmas, simple molecular manipulations, combined with a few organic subsystems thrown into the mix as modeling structures, might well one day prove to be the path for finding the power in the dark between the stars.

The Face of New Energy

Wil Brown*

The future of an inexhaustible supply of energy, both in the form of electricity and in heat, would be the beginning of a kind of Utopia. People in third-world countries could begin to catch up with the developed world. Though it is hard to see what would happen to oil producing countries, I imagine they could find a use for their supply of crude.

Oil will probably continue to be useful as lubricants well into this century. Though oil is still used in the manufacture of polymers, a better way to do this is already being explored. Gone will be the smog that now blights our cities, choking our lungs and obscuring our views of the mountains that people flock to those areas for in the first place.

The era of a fossil-free age is pretty much here right now. Every home will be able to disconnect from the power grids and hook up a cold fusion generator and power a small villa with a continuous supply of energy that would never fail because of weather. No more towers, no more power lines criss-crossing our streets, cities and countryside. And most important, nuclear generators costing billions of dollars will never be needed again.

I understand the term "cold fusion" can't be used in the presence of frail, mainstream scientists due to their paradigms regarding fusion. And indeed, it may turn out to be an entirely new field of physics that will explain what is happening to produce this excess heat, or not. Either way, it is here. It is now. And no matter how hard these shortsighted scientists try to disprove it, it is a reality. And nothing will make it go away.

The problems that alternate energy scientists face is not just mainstream science. This is the birth of new technology. And like the birth of anything, it hurts and it's messy. But in the end we will have a bright new world powered by new energy that will solve all the world's energy needs.

I envision transportation getting the best from this new energy. If science can use new energy to produce enough power, automobiles could be propelled not by electric motors, but by field propulsion and field effect levitation instead of wheels. These computer-controlled vehicles could be used by anyone via voice commands. Perhaps mass transit will make a comeback. Even airplanes could use powerful electric turbines to force air through ducted fans to propel itself at high speed through the lower atmosphere (below twenty thousand feet). Boats too would benefit. Anything that uses engines to move could use new energy instead.

New energy will indeed change the face of the earth forever.

About the Author

Mr. Brown received his B.S. degree in Physical Science from the University of New Hampshire after only thirty-six months. He was invited to attend MIT's Computer Science & Technology class in 1969 with a possibility of teaching there after graduating. He stayed at MIT for three years before moving to Keene, New Hampshire to teach Computer Programming at Keene State College. Mr. Brown served in the U.S. Navy as well. His wife of twenty years, Bessie, passed away in 1991; they had three children, now all grown. Mr. Brown currently works in the broadband industry setting up computers to receive and transmit over the internet at 2 kilobytes throughput.

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"A Matter of Matter"

Bruce Gill*

Future?
Fusion?
Fission?
Matter?
Antimatter?
What's the matter?

The matter that will fuel the next generation of power
May be just around the corner.
Someone will be thinking "outside the box."
There is no box!
It is a circle.
A circle that binds together all things.
Everything is dependent upon everything else.

A new energy?
Consider the fact there may not be one.
That our energy answer is just past the horizon.
As we keep moving forward we are no closer to the answer.
Only to return to where we began.
What is the future of energy?
What form of matter?
We are the matter.

About the Author

Mr. Gill is head engineer at Johnson High School in St. Paul, Minnesota. He started his "energy career" as a boiler technician in the U.S. Navy. Mr. Gill says he "has always been intrigued and concerned about energy technology and use."

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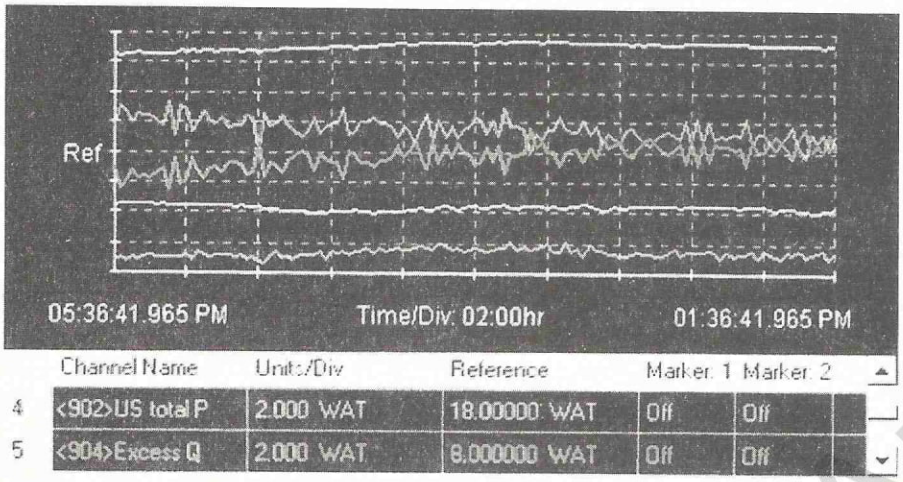

Figure 4. The excess heat run data for the third and final segment of this data file. The SEC heat at the top of the graph stabilizes at the same time that the excess heat reaches the maximum of 8.5 watts, average. The ultrasonic power input stabilizes at about 19 watts, for an excess heat of 40% for the reactor. The excess heat is believed to be from the fusion of deuterium into helium.

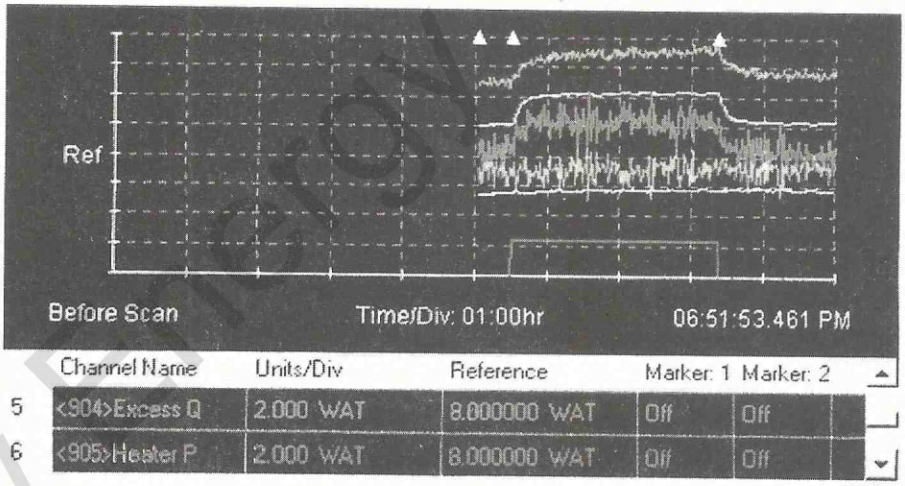

Figure 5. While the sonofusion reaction was running, a 2.3 watt pulse of heat was applied inside the SEC. The heat detected by the SEC rose by 2.3 watts. If the excess heat of 8.5 watts out of a 19 watt input were an artifact of a drifting calibration, the 2.3 watt extra input would have measured as a rise of about 3.2 watts. This calibration check proves that the scaling of the SEC did not change. The sampling rate was once every minute in this data logger run. The traces are, from top to bottom, reactor temperature, SEC heat, excess heat, ultrasonic power, room temperature, and joule heater power. All are spaced vertically for the convenience of viewing. All of the power traces are 2 watts per vertical division.

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Ken Rauen

Solid, 8.5 watts excess heat, 40% over-unity, S/N > 40/1 achieved.

In late 2000, NERL selected one of Roger Stringham's sonofusion processes as the best method of demonstrating cold fusion via a commercial device. It has been our intention to replicate the excess heat, and then to clean up Roger's design for small scale production of the reactor and associated instruments. In this way we will be able to reliably demonstrate cold fusion *on demand* to anyone with minimal experimental skills. We replicated the excess heat with Roger's reactor and calorimetry, but did not always find excess heat as Roger had claimed for his setup. Likewise, what we found was a maximum of 30% excess heat, not the 100% excess heat which he claimed to see with the same device. We built a version more suitable for sale, but until this time had never found any excess heat from the new reactor. New ultrasonic wattmeters from Pioneer Microsystems allowed us to move the ultrasonic oscillator electronics outside of the Seebeck envelope calorimeter (SEC), so that only the reactor, a circulation fan, and calibration resistors are inside the SEC. This sequence of events in our experimental program was covered in detail in previous issues.

Lacking the ability to hire a consultant in piezoelectrics and ultrasonics, we have had to learn some things on our own. We thought that the Crest oscillator was operating at the resonance of the piezoelectric ceramic transducers, but we were wrong. The resonant frequencies we reported in the last issue were not an indication of a drift of the system's operation. We measured electrical impedance and plotted it. See Figure 1. The complex impedance of the piezos is influenced by many factors. Crest uses a 5 mH coil in series with each piezo, which changes the impedance curve, generally lower in impedance and with slight shifts in the multiple resonant frequencies. We now do not know where the system will produce the desired acoustically induced fusion events. Since the 38 to 39 kHz pulsed sweep used by the Crest electronics is not over any resonance of the piezos, we do not know what conditions to establish in a new oscillator. Even Roger does not know what is going on, as he never changed any parameters in this sonofusion system; it always ran the same way, which always produced excess heat. His other system designs have produced excess heat, and greater heat at that, but not repeatably, so this is why he recommended the Crest oscillator swept system for a commercial demonstration device.

To further understand what has been happening, we reassembled the original reactor from Roger—finicky seals, connections, and all. It did not produce any excess heat. We then tried to figure out what had changed. Neither Roger nor Crest, the manufacturer of the ultrasonic oscillator used by Roger, knew what had happened.

When we built the new, smaller reactor, we selected titanium endcaps for the piezoelectric "stacks," the transducer assemblies. These titanium "radiating bars," as the piezoelectric industry calls them, are not cemented to a stainless steel water bath, as they are in jewelry cleaners. The radiating bars are the reaction chamber surfaces which are directly exposed to the heavy water in our unit. Roger found nearly all of the metals he tested to have active fusion sites, even when there was no target foil inside the reaction chamber and all that remained was the metal chamber itself. Titanium was found to be an active metal and he recommended that we use it for our exposed piezo stack surface. Normally, aluminum is used for the radiating bars, but aluminum will be easily damaged by the acoustic energy, just as we saw with the copper target, reported earlier. The radiating bars must have a low density in order to transmit the acoustic energy without significant attenuation. Steel is too dense, so titanium was selected, as it also is resistant to ultrasonic erosion.

In an effort to narrow down the nuclear reaction pathway, the new reactor with the titanium in the stacks was first tested with deuterium-depleted water, 3 ppm deuterium. No excess heat was found, as anticipated. Then the water was replaced with normal, distilled water; again no excess heat was found. That water was replaced with heavy water, which is 99.9% deuterium oxide. This time the excess heat *was* expected, but again it did not occur. This was reported in a prior issue. It turns out that titanium forms a stable hydride, derived from the hydrogen of the water. The protium oxide exposure may have "poisoned" the titanium against excess heat production. Since the hydride is so stable, it is not likely to establish an equilibrium reaction with the water to exchange hydrogen isotopes. The protium in the hydride seems to remain there. We hypothesize that if deuterium does not get into the metal lattice, fusion does not significantly occur.

The protium hydrided titanium radiating bars were machined to expose fresh titanium under the surface. About 0.020 inches were machined off. No excess heat was found with the exposed titanium. We do not know how deeply the hydride layer forms, so we may not have removed all of the protium. Much more cannot be removed, because the thickness is critical to the mechanical resonance of the stack.

New titanium piezo stacks were installed. Finally, excess heat appeared—this time in a major way. One test was run for 57 hours, establishing excess heat long before thermal equilibrium was obtained 11 hours from the start, reaching 8.5 watts, 41 hours from the start. No "heat after death" was observed. With approximately 20 acoustic watts of input (estimated to be around 195 dB

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Energy Efficiency Expo

June 2-5, 2002
Palm Springs Convention Center
Palm Springs, California

www.energy2002.ee.doe.gov

Windpower 2002

June 2-5, 2002
Portland, Oregon

Watch www.awea.org for information as it becomes available.

Rio-02

Energy Policies and Technologies for a Sustainable Future

January 6-11, 2002
Rio de Janeiro

www.rio02.org
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Watch for coverage of the 3rd Japan Meeting on Nuclear Reactions in Solid (JCF3) in Issue 41 of *Infinite Energy*.

The Ninth
International Conference
on
Cold Fusion
(ICCF9)

May 19-24, 2002
Beijing, China

The Ninth International Conference on Cold Fusion (ICCF9)

has been scheduled at the International Convention Center, Tsinghua University, in Beijing, China from May 19 to 24, 2002.

The study of Cold Fusion (CF) phenomena, sometimes referred to as "New Hydrogen Energy" (NHE) is progressing in numerous laboratories all around the world. More than ten years old, the field is enjoying ever more reproducible experiments and better interactions with the scientific community. A large variety of experimental approaches will be addressed at the Conference, together with theoretical attempts to interpret the observed phenomena.

The important sponsorships that have been secured for ICCF9 (Fundamental Research Division, Ministry of Science and Technology Physics Division II, Natural Science Foundation of China, Chinese Nuclear Physics Society, Department of Physics, Tsinghua University) guarantee that the Conference will maintain the most rigorous scientific standards. As stated in Lerici at ICCF8, the theme of ICCF9 will be coherence: Coherence between Nuclear Physics and Solid State Physics; Coherence between Cold Fusion and Hot Fusion; Coherence between Research and Development. We are glad to see the progress in all three aspects in the past years.

The following are some topics that will be covered at ICCF9: heat and related products; nuclear processes and transmutations; materials; innovative approaches; and theories.

The Conference will consist of oral and poster presentations. The official language of the Conference will be English.

Pre-registration, registration, and submission of abstracts should preferably be performed using the Conference website, which will be updated regularly, and will provide all necessary information and interactive procedures. Those who do not have access to the Internet are kindly requested to contact any one of the Conference Secretariats.

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Watch the ICCF9 website for updated information as it becomes available.

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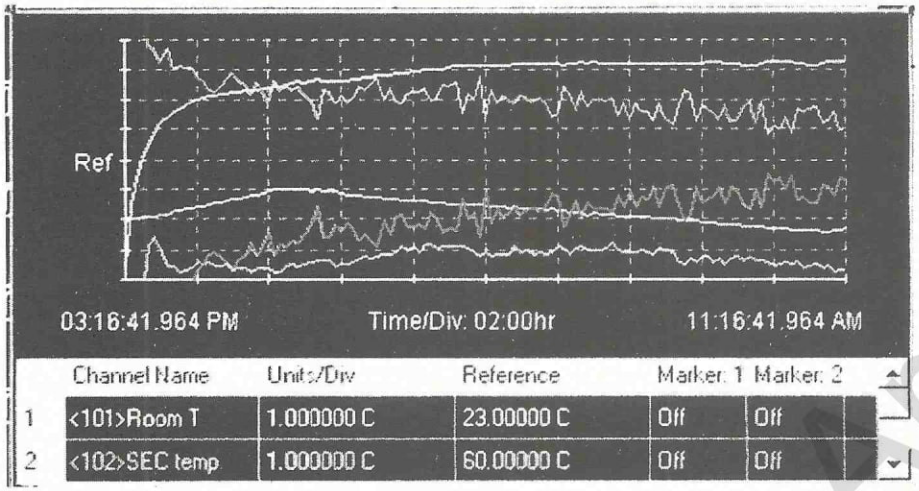

Figure 2. The excess heat run data from the Hewlett-Packard BenchLink data file is displayed in three overlapping segments. The first segment is in this figure. We apologize for the imperfect display of the BenchLink graphics; the HP software and Microsoft Works do not work well together. Each line on the graph has unique settings for vertical scale and offset in order to present the data most clearly. The legend below each graph in Figures 1 through 3 identify the settings for each line; all five traces are identified, only two identified in each figure. The vertical scale is in units per division and the vertical offset is the value at the center line, marked "Ref" for reference. The lines are identified from top to bottom at the right side as SEC heat, ultrasonic power, excess heat, room temperature, and SEC temperature.

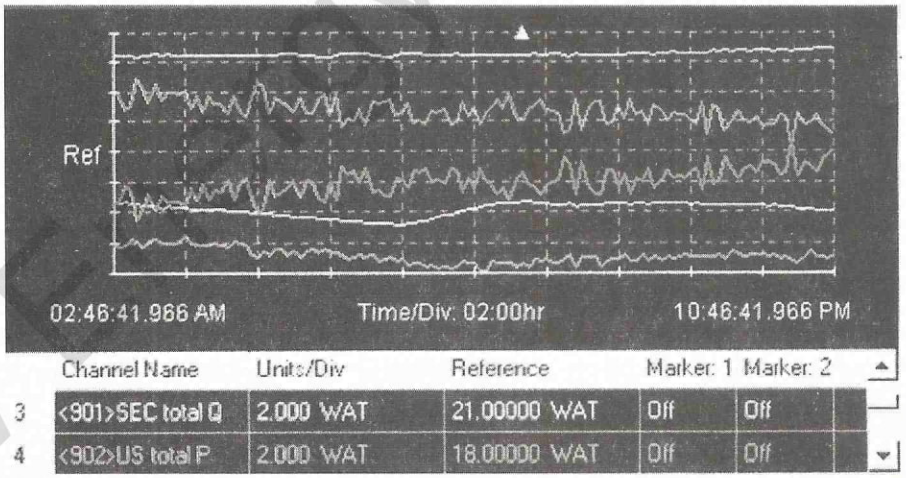

Figure 3. The excess heat run data for the second segment. The triangle at the top indicates when the air conditioning was turned on. The zero for the excess heat trace is the bottom of the graph, so that whatever is shown is positive, being truly excess heat. It is still climbing, hypothesized to be caused by the gradual loading of deuterium into the titanium lattice. The noise of the excess heat is caused by the noise of the ultrasonic power, which is caused by the sampling rate of the datalogger (once every 10 minutes) being slightly out of synch with the ultrasonic power pulses (120 per second). Long-term averaging of this signal has proven to be accurate.

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hesitantly approve of nuclear power. Many economic conservatives and free market think tank organizations, such as the Cato Institute, oppose it. Most electric power company executives want nothing to do with it, because the financial risks from a construction cost overrun or an accident are too great. The power companies in Japan want to freeze or cancel the construction of three large plants, but some conservationists and the government are pushing them to continue work on them. In Germany, the government has pledged to phase out all nuclear plants by 2030. The decision has met with widespread public approval. In France, which depends upon nuclear power for 80% of its electricity, the public generally supports nuclear power, although the government does not plan to build any more reactors.

Let me openly state where I stand on this divisive and deeply troubling issue, so the reader will know where my sympathies lie. Like most members of the public, I am ambivalent. I wish there were better alternatives right now, especially cold fusion. In many areas wind power is better. It costs a little more, but I would be happy to pay extra. However, the wind is not strong enough for economical power generation in many parts of the world, including the ones where I live, in the southeast of the United States and in western Japan. If I had to choose between living near a nuclear plant or a coal-fired plant, I would pick the nuclear plant. In my case this is not a hypothetical preference. A new nuclear plant is being built roughly 20 kilometers away from our family home in Japan. After careful consideration, I support limited continued use of nuclear energy, until something better emerges. It would be foolish for countries like France, Germany, or Japan to close down existing reactors prematurely, years before they reach the end of their licensed operating life, as some opponents have urged them to do. These countries have high population density, serious air pollution, and a large pool of experts to operate their reactors. It would be best to let the industry die gradually, as plants wear out. It is dying anyway, despite huge subsidies and sixty years of government pampering.

The advantages of nuclear energy are clear. It is inexpensive and cleaner than most other existing large-scale generation technologies. It does not contribute to carbon dioxide buildup, which may cause global warming. Uranium is as common in the earth's surface as tin. Although the U.S. imports uranium from Canada, it has plenty in the ground, as do many other countries, so there can be no uranium shortages or cartels. The list of reasons why we should fear and oppose nuclear energy is much longer, and more complex. It is described in the remainder of this article.

Physical Risk

Most people fear another major accident more than anything else, for good reason. Although U.S. and Western European plants are far safer than the Chernobyl reactor (the Chernobyl design would never have been permitted in the U.S.), they have had many fires and accidents that released radioactive gas or contaminated water, and they are vulnerable to a catastrophic meltdown. The containment buildings in European and American plants are designed to withstand most accidents, but they would probably not survive a full core meltdown. The molten uranium and steel would probably breach the floor and cause a steam explosion, which might release roughly as much radioactive material as the explosions from 1,000 nuclear weapons (Gofman, 1971). A power plant can never explode like a nuclear bomb, but it might cause tremendous harm. During the Three Mile Island (TMI) accident in 1979, one-third of the core melted.

Before TMI, experts said even partial meltdown was impossible. Now they say another meltdown is highly unlikely. They are probably right. Industry critics and watchdogs agree that safety standards, training, instruments, and controls have improved significantly since TMI. The problem is that a meltdown is an "all or nothing" risk. It is highly unlikely, but if it does happen, the potential damage may be much worse than any other industrial accident in history. In 1957, an unpublished study from Brookhaven National Laboratory estimated that in a worst-case accident an area the size of Pennsylvania might be contaminated. Even if no one died in a major accident, the lives of millions of people might be ruined. The risk is difficult to quantify or estimate, because there are not many reactors in use, and they have been re-engineered and upgraded since the TMI accident.

A less dramatic but more likely risk is a low-level accident, or partial destruction of the core, costing fantastic sums of money. A 1989 accident damaged the reactor core at the Connecticut Yankee plant, releasing radioactivity into the surrounding community. Several clean up attempts were made, and hundreds of millions of dollars were spent in vain, but the reactor had to be shut down for good in 1997, years ahead of schedule. It will cost a great deal more to clean up.

Finally, nuclear fuel may be lost or stolen. Even a few kilograms of fuel or a barrel of low-level rad waste (used clothing and so on) could cause unthinkable harm if a terrorist or a stupid thief got hold of it.

In the wake of the September 11 terrorist attack, experts are rethinking nuclear power plant safety, and beefing up armed guard protection. The plan to move nuclear waste to Yucca Mountain faces increased opposition. Opponents fear that radioactive material in transit will be particularly vulnerable to attack or accident, in what they call the "mobile Chernobyl" scenario. Following the September 11 attack, a member of the Union of Concerned Scientists remarked that "no one [is] calling his colleagues in the alternative energy sectors to ask about terrorist threats to windmills. . ." While the attack does make the most lurid fears seem credible, on balance I do not think that a fission reactor is a promising target, because there are so many other vulnerable, unprotected factories, refineries, and so on. One of the largest petroleum storage depots in the southeast is a few miles from my house, in Doraville, Georgia. I drove by a month after the attack, and saw no sign of guards. There is no gate blocking access to the

The advantages of nuclear energy are clear. . . The list of reasons why we should fear and oppose nuclear energy is much longer. . .

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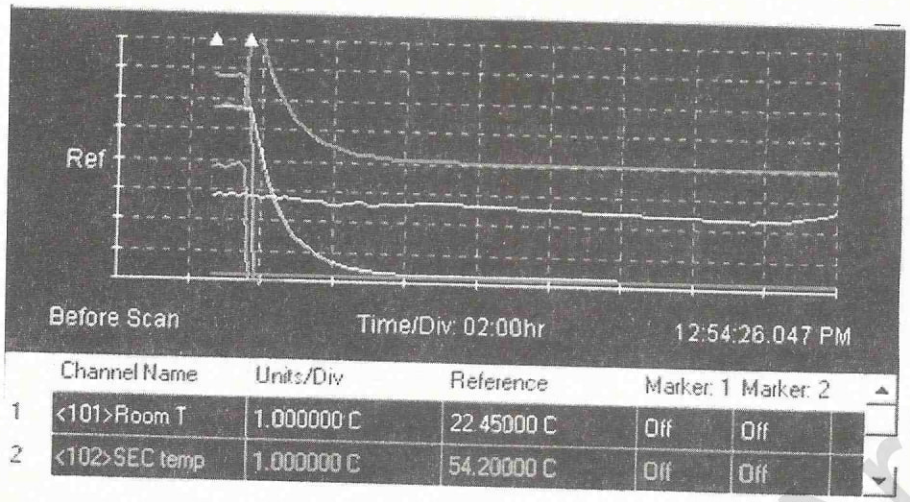

Figure 6. The sonofusion reaction was terminated shortly after this data logging run was started. The ultrasonic oscillator was shut off. At this point, the heat remaining in the SEC was calculated as excess heat, the spike which rose off the graph. Thermal equilibrium was reached in several hours. The excess heat measurement settled at +0.2 watts, indicating the measuring system did not develop a significant zero drift. This second post-calibration test, in combination with the first post-calibration heat pulse input, proves that the instrumentation was operating accurately. The excess heat measured is legitimate. The traces are identified, from top to bottom on the left, as SEC temperature (which falls rapidly off the graph), excess heat (which is zeroed at the reference line and therefore could show a negative excursion and thus display a system error), SEC heat (which coasts asymptotically to the bottom trace), ultrasonic power (which falls rapidly off the graph), room temperature, and circulation fan power (what the SEC heat line was converging to). The circulation fan and SEC heat lines are zeroed at the bottom of the graph. At the end of this run, the +0.2 watt excess heat was the error between the SEC heat and the circulation fan's DC electrical power input.

sound pressure level), 8.5 watts of excess heat is about 40% over-unity.

At 46 hours into the run, the program was changed to monitor a resistance heater pulse input to the SEC. The purpose of this test—an on-the-fly calibration—was to document the scale of the SEC calibration, to make sure that it had not changed. We put 2.3 watts of regulated DC voltage and current into the resistor for 3 hours, and a 2.3 watt stepwise rise was seen in the heat detected by the SEC, verifying that the scaling of the SEC had not drifted. Next, the ultrasonic oscillator was shut off and the SEC heat was allowed to drift to thermal equilibrium; this checked the zero of the system calibration, as the ultrasonic wattmeters were still on. The system drifted to +0.2 watts of excess heat in 14 hours. See Figures 2 through 6 for a graphic display of the results.

The excess heat measured was validated. Though we successfully replicated Roger Stringham's work earlier this year, this robust result feels, at this writing, much more secure. Our previously stated goal of this replication effort had been to take this cold fusion system to a commercial product. Finally, we are close to doing just that. As this issue goes to press, we are building a second set of hardware. If it also produces excess heat, we will build a total of ten systems. If most of these produce excess heat, we will go into production of demonstration devices for sale. We hope that in the next issue of *Infinite Energy* we will be able to announce the availability of these long-awaited tangible proofs, which we have needed so badly. The skeptics said they would only believe cold fusion is real if they could buy a device at K-Mart. These will not be sold in K-Mart, but the skeptics will be able to buy them from us instead. Stay tuned.

We still intend to do a systematic search to identify the "sweet spot," the exact conditions which cause the fusion of deuterium into helium in an acoustic field. The Crest oscillator produces a burst of ultrasonic power, which changes in frequency as it rings down to zero amplitude; we do not know what the precise conditions of the fusion events are. Our search will be done with a constant amplitude, 100% duty cycle, sine wave oscillation. Once we identify exact conditions, it will be possible to excite the water continuously with ultrasonic energy and produce far more excess heat, which may make this process viable for steam production to power a turbine and generate electricity. ■■■

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than 100 different types of reactor have been operated. The number of different types under development grows constantly smaller, and the political authorities in various countries eliminate the riskier versions for reasons of economy. There now exist only about ten types of nuclear power stations that have any hope of survival, and is impossible under present conditions for a radically new type to receive a fair trial." He thinks the types we have now are obsolete. This issue is seldom explored in the mass media. Some commentators criticize nuclear reactors as an obsolete, overcentralized and oversized technology, without delving into how it came to be that way.

Dyson and others favor a "passive safety" design, like the Triga, which does not depend upon control rods, pumps, emergency cooling water, and other engineered devices to prevent a meltdown. When operator controls are set for unlimited power and no heat is removed from power generation, instead of heating itself up in a positive feedback loop, the reaction quenches. The news media has recently described a promising "pebble bed" reactor design with passive safety. The pebble bed type would probably be cheaper to build and operate than conventional reactors, and it would be economical in 100 to 200 MW plants. Conventional nuclear plants are only economical at 900 MW or more, which is too big for today's market. A 114 MW pebble bed reactor is scheduled to be built in South Africa in five years.

Experimental reactors may be needed, but they are more likely to cause accidents than conventional reactors. In Japan, conventional reactors have had few serious accidents, but the breeder reactor program has been plagued by financial and technical difficulties. The 280 MW prototype Monju breeder reactor was years late and billions of dollars over budget. It is cooled with liquid sodium, which bursts into flames on contact with air. In 1995, soon after the plant opened, 640 kg of sodium leaked out of the cooling system and caused a fire. The plant management tried to conceal the incident from the public, but details leaked out and caused a furor. The Monju website and the Japanese government insist that the accident was not serious, but the plant is shut down, and most observers say it will never reopen. It is difficult for a non-expert to judge whether this is an overreaction or a prudent step. In any case, it illustrates why no technology can survive without the support and confidence of the public.

Other breeder reactor plants have had fires from conventional chemicals, which caused toxic chemical smoke. At the Tokaimura fuel preparation plant, workers ignored basic precautions and mixed too much fuel, causing a criticality accident that killed two workers and forced a large evacuation. Even if the breeder program could be completed against stiff opposition from citizen groups, the Japanese government now concedes that the electricity these plants generate would be more expensive than electricity from conventional plants.

An experimental program to burn plutonium-uranium oxide (MOX) fuel in conventional reactors has recently run into serious political opposition from a prefectural governor and citizens groups, because of safety and nonproliferation concerns. MOX is three to six times more expensive than ordinary uranium fuel, according to the World Nuclear Association. It might be stolen and used to make a crude nuclear bomb, according to a recent article in the *New Scientist*.

Waste Disposal

This subject is beyond the scope of this essay. Briefly, some experts question the long-term safety of the Yucca Mountain site. The DOE claims that the rock formations and water table will "keep the waste sufficiently isolated for thousands of years so that the radioactive material will pose about the same risk or less risk of health effects to the public as that of unmined uranium ore." If this is true, it is hard to imagine a more satisfactory waste disposal method. I cannot judge this issue, so I relayed the DOE comment to critics and nuclear industry watchdog organizations, but they did not comment. There seems to be a disconnect regarding waste, as if opponents would prefer not to find a reasonable solution.

Some researchers connected with cold fusion claim they can "remediate" nuclear waste; that is, speed up the reaction the way a breeder reactor does, to exhaust most of the fuel, thus shortening the time it would be dangerous, from ~200,000 years to a few centuries, or even faster.

Accidents

The Chernobyl accident was caused by the nuclear reaction itself, but most serious accidents in the U.S. and Europe have been caused by problems with conventional equipment such as sticky valves, clogged pipes, corrosion, rust, and frayed wires. Such problems are bound to crop up in any factory. Other accidents have been caused by stupidity, bad engineering, and such things as emergency pumps that do not work because they were installed backward and never tested. A few problems have been caused by criminal negligence, such as the Connecticut Yankee plant that was run for a year even though management knew the reactor core was damaged and leaking radioactive debris inside and outside the buildings.

With better equipment and improved training, problems at nuclear plants will be reduced year by year, asymptotically approaching zero. It is impossible to ensure that they will never occur. Just as a few large airplanes are likely to crash every year, a few nuclear power plants will probably experience serious accidents. The main cause of accidents in airplanes, nuclear power plants, and other large, dangerous machines has always been the human factor: the operator, and the man-machine interface. Hundreds of mistakes are reported every year in U.S. reactors, most of them inconsequential. No matter how many instruments are installed and how carefully people are trained, they may overlook a sticky valve, a slightly bent lever, a slow leak, and accidents are usually triggered by such seemingly minor problems. Perhaps in the distant future intelligent robotic computers will take over the job and reduce the likelihood of accidents so much that a nuclear power plant may be run for millions of years without a single accident, even a minor slip-up, but human operators will never achieve such perfection.

A fossil fuel plant or an oil refinery might cause a serious accident, but the stakes are not as high. In the worst-case accident, an explosion at a fossil fuel plant will probably kill a small number of people in the immediate surroundings. It may cost as much as it takes to clean up and rebuild the facility from scratch. Cleaning up the TMI accident cost $1 or $2 billion, compared to the original construction cost of $600 million, and the reactor is permanently out of service. (The

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Some Thoughts About Nuclear Fission Power Reactors

Jed Rothwell

The Bush administration has announced that it will promote nuclear energy. Polls show that public support for fission power has now reached about 50%, which is higher than it has been in many years. Nuclear power plants have not been built in the U.S. since 1985, and the industry is considered moribund. In California, by law new nuclear power plants cannot be built until a site for permanent storage of the nuclear waste has been selected. The Federal government has spent billions of dollars developing a permanent underground nuclear waste dump in Nevada, but the state government, congressmen, and many citizens in Nevada are upset by this plan, and vow the site will never be opened.

There is deeply rooted opposition to nuclear energy. Some of it might be dismissed as ignorance. People do not realize that coal-fired plants put more radioactive material into the atmosphere than uranium mining and nuclear power plants do. However, some opponents are intelligent, well-informed people. Thoughtful people who favor nuclear power should feel uneasy about its risks and trade-offs. Serious nuclear accidents have occurred in England, the U.S., Japan, and Russia. A disaster even worse than Chernobyl is possible. No one can say how likely it is, but it cannot be ruled out. The power companies themselves do not rule it out; they refuse to operate nuclear power reactors without a guarantee from the government that they will not be held financially liable for a catastrophe.

The dispute is often portrayed as left/right political split, with liberals against nuclear power, conservative businessmen in favor of it. Actually, the division is more complicated. Some conservationists, both liberal and conservative, who are concerned about global warming and pollution from fossil fuel,

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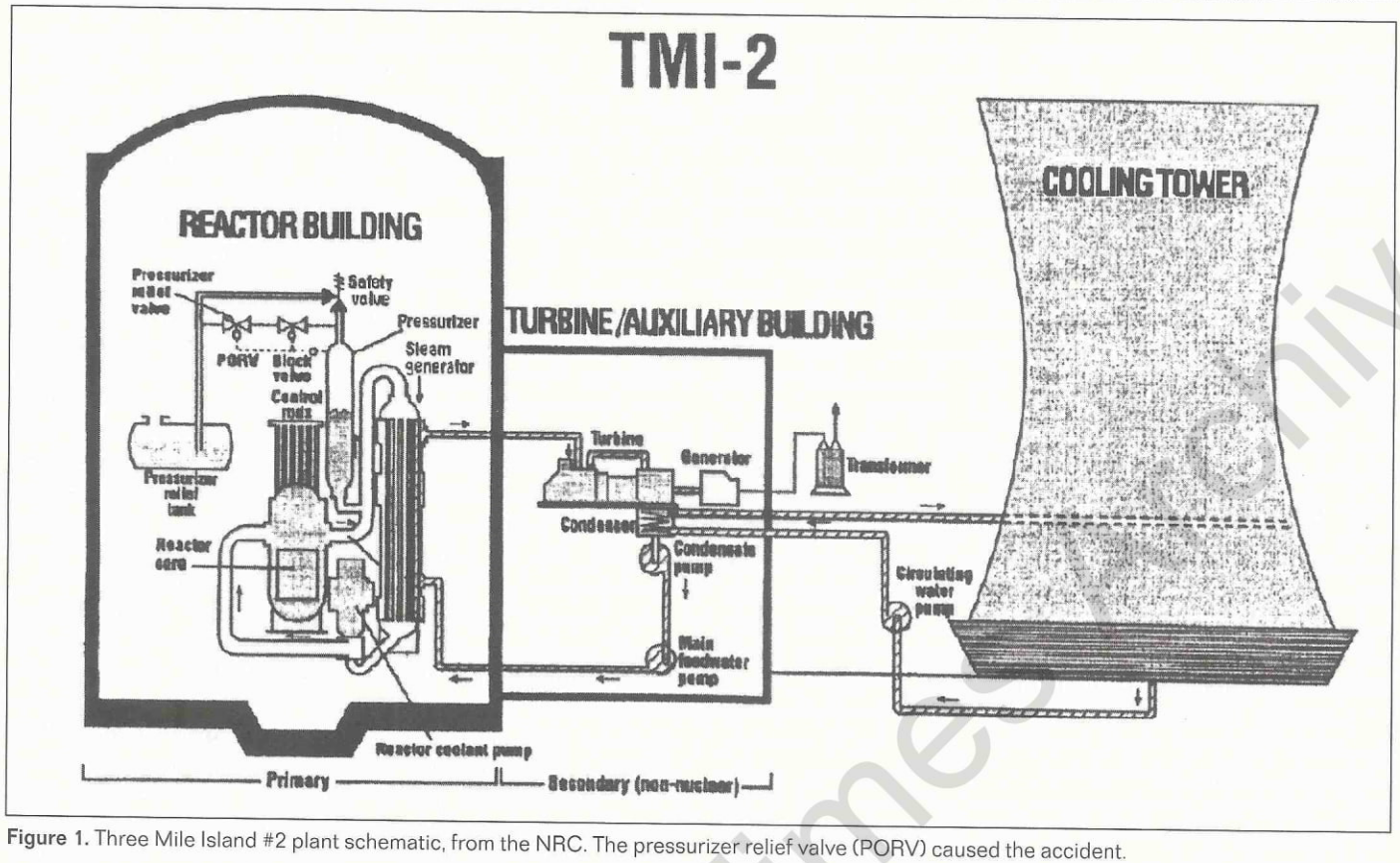

Figure 1. Three Mile Island #2 plant schematic, from the NRC. The pressurizer relief valve (PORV) caused the accident.

damage was averted, but the weakness in the valve, the controls, the pressurizer-water-level-indicator, and operator training caught the attention of several low-level officials, including an engineer at Babcock and Wilcox (B&W), the company that made the reactor, and James Creswell, an inspector from the NRC. Creswell researched the problem and found a weakness in the design of the nine nuclear plants made by B&W that was causing the pressure release valve to open more often than normal. He also found that the valves had jammed open in nine incidents, because of various mundane problems with electrical controls, warping from heat, a buildup of chemical contaminants, a bent bracket, and so on. He made sensible, modest, and inexpensive recommendations: a warning should be issued, new operator procedures drafted, the relief valves in B&W plants tested, and a warning light showing the position of the valve should be installed in the reactor control rooms. Creswell wrote an escalating series of memos to NRC officials, trying to bring attention to the problem. He was severely criticized by the reactor manufacturer and utility companies, harassed, and told that he was overstepping his authority. The NRC declared that the valves were not "safety related equipment" so no action was needed. The engineer at B&W also recommended new procedures and safety inspections. In a memo he wrote: "Had this event occurred in a reactor at full power . . . it is quite possible, perhaps probable, that core uncover and possible fuel damage would have resulted . . . I believe this is a very serious matter . . ." Management took no action on this memo, and did not notify plant operators or the NRC of the problems.

On March 28, 1979 at 4:00 a.m. in the morning, operators at another B&W plant, Three Mile Island #2 (TMI), were cleaning a water filter. They were trying to clear out a clogged pipe with compressed air, when they accidentally interrupted the main feedwater flow. This triggered an automatic shutdown of the generator turbine and the nuclear reactor, which was running at full power. Just as it did at Davis-Besse, the shutdown caused a brief surge in feedwater pressure, which triggered the pressure relief valve. No one knows why, but for the tenth time on record in a B&W reactor, the pressure relief valve jammed open, and 220 gallons per minute began draining into a holding tank. When the TMI control room was built, like Davis-Besse, it had no valve-open warning light. However, in 1978 the TMI valve jammed open because of a blown fuse, so the plant engineers devised a jury-rigged warning light labeled with a handmade sign. Unfortunately, they connected the light to the valve actuator electronics, not the valve itself. Although the valve remained open, the electronics indicated it had shut correctly, so the warning light stayed off, and the operators saw no indication of a problem. Because B&W and the NRC never told the operators about the Davis-Besse accident or about the problems with the pressurizer-water-level-indicator, they made the same mistake as the Davis-Besse operators, and turned off the emergency cooling pumps.

Although the operators could not tell the valve was open, they sensed something was wrong. The reactor was not cooling properly, the pumps were vibrating, water pressure was dropping. Nine minutes after the shutdown, they found a serious problem. Two days before the accident, someone performing routine maintenance shut two

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tanks. Anyone can drive in and park a few feet away from a tank. A major fire occurred there in 1972, killing two and injuring 161 people.

Financial Risk

The cost of cleaning up the TMI accident nearly bankrupted the power company. Accidents are inevitable, and even a small one that is no threat to human life is expensive. Buying a conventional nuclear plant amounts to a bet: it may pay off moderately better than a coal or wind plant, or it may put you out of business. No accident at a coal, gas, or wind plant can do that. Most nuclear plants in the U.S. went over budget during the construction phase. The last ones constructed were supposed to cost about $1 billion each, but some ended up costing as much as $7 billion. The plants take so long to build, five to seven years, that by the time one is complete the local market for electricity may have gone from shortage to glut.

Artificially Limited Liability

The electric power companies and reactor manufacturers refuse to accept full liability for accidents. The Price-Anderson act of 1956, as amended in 1988, limits the liability of power companies to $7 billion for a single accident. No other industry in the U.S. is protected this way. If the nuclear power industry had to bear the full cost of insurance, the cost of nuclear generated electricity would be higher, and less competitive with coal and wind. The potential risk is so large, the industry might not even find a pool of private insurance companies willing to provide coverage. Free market think-tank intellectuals disparage the nuclear industry for this reason. They consider it socialistic, and they say Price Anderson is a subsidy that distorts the market for energy. The DOE includes the act in a list of federal energy subsidies, estimating that it saves the industry $3.6 billion per year in insurance premiums. In the event of an accident, the power company would pay at most $7 billion, and the government's liability for damages above $7 billion would be unlimited.

Power companies say they will not operate nuclear plants without Price-Anderson. This means the power companies (or perhaps only the insurance companies) believe that another major accident is possible. After all, $7 billion is a lot of money; it would take a meltdown or some equally catastrophic accident to exceed this limit. The most expensive conventional power plant accident in U.S. history was the explosion of the Rouge River plant, in February 1999, which killed six workers, severely injured fourteen, and cost $1 billion. If the power companies thought a second TMI is so unlikely that it is virtually impossible, or a once-in-ten-million-years event, they would not care about liability. They are the experts; if they think another catastrophe is worth worrying about, I must agree.

Pollution, Use of Space, and Resources

Nuclear power does pollute less than fossil fuel, and it does not threaten global warming. Even opponents agree, and opposition to nuclear power is waning partly because of these advantages. Nuclear power plants are compact, taking little land space, but they may take up more aggregate space than conventional fossil fuel plants. They must be built on a large scale to be economical, which means they must reach more people, which means they require more large, high voltage transmission lines. Uranium is chemically poisonous, like lead. Until 1978, uranium mining was poorly regulated. The mining industry health and safety record was appalling. Tailings were left to pollute the landscape and seep into water supplies. Miners and their families suffered from heavy metal uranium poisoning and cancer from radioactivity. The Uranium Mill Tailings Reclamation and Control Act of 1978 forced the industry to clean up, and these problems have been greatly reduced. The Federal government assumed liability for cleaning up mills and tailings abandoned before 1978.

Nuclear power plants with once-through cooling systems consume millions of gallons of water per day for the cooling towers, as do coal plants, and they release hot water which damages river ecology. Closed loop cooling systems ameliorate this problem at a modest cost. Nuclear plants use more water than fossil fuel plants because they run at lower thermal efficiency, because the fuel is cheap and lower efficiency reduces wear and tear on the equipment. Wind turbines consume no water. Offshore wind turbines take up no land space. They are more cost-effective than land-based turbines and they last longer, because sea breezes are strong and steady. In the E.U., offshore wind turbines could produce two to four times as much electricity as those nations consume.

High Cost

Uranium is cheaper than any other type of fuel, costing roughly 2 cents per kilowatt-hour of electricity. Coal costs roughly 4 cents. Natural gas prices have tripled in the last few months, to roughly 12 cents per kilowatt hour. Wind and solar power have no fuel cost.

The capital equipment—the power plant itself—is much more expensive than any other type, ranging from $3,000 to $4,000 per kW of capacity, compared to $500 for coal or gas, or $1,000 for wind. By law, nuclear plant operators must put aside 0.1 cent per kilowatt-hour to cover the cost of a permanent spent fuel repository. Other surcharges are supposed to cover the cost of decontaminating and decommissioning the power plant and the enrichment plants where uranium is prepared.

Despite the surcharges, electricity from nuclear power plants is reasonably cheap, but experts dispute whether these surcharges will be enough for all eventual costs. Only a few plants have been fully decommissioned and no waste has been permanently stored yet, so there is little experience to go by. Whatever it finally costs, decommissioning is much more expensive and problematic than it is with fossil fuel or wind plants.

Obsolete Designs Grew Too Big, Too Soon

Freeman Dyson, who worked on the General Atomics Triga reactor in the 1950s, says the nuclear power industry grew too quickly, and standardized too soon. It needed a longer period of experimentation with a variety of different designs, but industry and government demanded standardization, profit, and rapid growth. Dyson says that most products evolve slowly in a competitive environment, whereas "in the worldwide effort to develop an economical nuclear power station, less

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The more you learn about the hazards and complexities of nuclear fission power, coal, and other conventional energy, the better cold fusion looks.

engineers or scientists. A simple computer, or even a programmable calculator, could have been devised to measure the outlet water temperature and pressure, look up a steam table in memory, and warn the operators when the core was exposed to steam instead of being covered by water.

Three hours into the accident the operators realized the problem was serious, and they called in more qualified engineers, who raised the pressure again. By that time massive damage had been done, and thousands of gallons of water mixed with lethal radioactive debris had spilled into the containment building, triggering alarms and evacuations. A life-threatening emergency was declared. Experts were flown in from around the country. The reactor core remained uncovered for many hours during the first two days, as the experts frantically struggled to understand what was happening. To bring the reactor under control they had to make pumps and other equipment work in extreme conditions it was not designed for. They tried to keep the radioactive gas and liquid from leaking out of the containment building, but they were forced to vent radioactive gas once. On the second day of the accident, an NRC expert testified to Congress that the core may have been "slightly damaged" with "perhaps one or two percent" of the rods exposed. Months later, it was determined that about a third of the rods melted. The official government report concluded that when the open valve was finally discovered, the core was probably thirty to sixty minutes away from "an irreversible core heatup and meltdown"—a catastrophic accident.

The root cause of the accident was complacency. The Kemeny Commission investigation concluded:

> . . . the belief that nuclear power plants are sufficiently safe grew into a conviction. One must recognize this to understand why many key steps that could have prevented the accident at TMI were not taken. The Commission is convinced that this attitude must be changed to one that says nuclear power is by its very nature potentially dangerous, and, therefore one must continually question whether the safeguards already in place are sufficient to prevent major accidents.

Most observers agree that the proximate cause of the accident was bad instrumentation. During the accident investigation, the control room design was evaluated by a company that specializes in ergonomics and safety engineering. The instrument layout failed 96% of the standard criteria. Daniel Ford describes the problem eloquently:

> The impediments in the TMI-2 control room to the diagnosis of serious accidents were so pervasive that the operators were kept totally ignorant of the fact that the reactor was hovering on the brink of the ultimate nuclear accident. They were frustrated and confused at every turn by missing instruments, unreadable meters, ill-placed monitoring devices, improperly designed switches, inaccessible emergency controls, inherently ambiguous signal lights, a useless computer, distracting and irrelevant alarms, and, most especially, perverse miscues about plant conditions. Only with unparalleled good luck could a handful of operators have been expected to overcome the difficulties posed by a control room so designed. [Operators] Faust, Frederick, and Zewe had no such large measure of good fortune, and they encountered no serendipity as they responded to what they thought initially was a routine, albeit unscheduled, plant shutdown. . .

The TMI accident resembles nothing so much as a very badly performed amateur experiment in calorimetry. The instruments gave false, misleading, and dangerous misinformation about conditions in the reactor. A thermocouple with a proper readout or a $1 contact switch on the valve would have prevented the accident. It is astonishing that in 1979, major national corporations spent $600 million on equipment they knew could destroy a city, yet they did not bother with safety techniques that have been common knowledge since the late nineteenth century.

Can It Happen Again?

Industry critics agree that nuclear power plant safety is better than it was in 1979. But are all the problems fixed? Have old plants been retrofitted with new control rooms? Can another accident cost millions of dollars and threaten people's lives? On one hand, the problems that caused the TMI accident were so trivial, and so easy to fix, they must have been fixed by now. We may have little left to worry about. Ten years after the accident, John Kemeny, chairman of the TMI commission, said: "The [industry's] improvements over the past decade have been impressive and are very reassuring." On the other hand, how can we trust an industry that made such stupid mistakes in the first place? The industry does not invite confidence. It remains closed and secretive compared to other high tech, high risk industries such as aviation. Detailed information on things like modern control room layout and ergonomics is difficult to obtain.

Appalling accidents still occurred long after TMI. After the Connecticut Yankee plant was shut down in 1997, an investigation revealed what the state Attorney General described as "a nuclear management nightmare . . ." He added: "The goal is no longer to decommission a nuclear power plant, but rather to decontaminate a nuclear waste dump." Serious accidents and mistakes had been covered up by management for years, and hundreds of millions of dollars were wasted in a hopeless effort to clean up, before the plant was abandoned. The fuel pellets were packed into obsolete stainless steel jackets instead of zirconium. The jackets were seriously punctured or cracked on two occasions. In 1989 metal scraps left inside the reactor vessel by a maintenance crew damaged a rod during refueling. Radioactive material quickly leaked into the surrounding coolant, but the reactor was left to operate for "a world record run of 461 days." The company knew about the fuel rod failure for months, and it knew that contaminated cooling water was escaping from the reactor. "Unmonitored floor and roof drains in radioactive areas of the plant deposited contaminated liquids directly into the

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plant was supposed to cost $180 million but the cost escalated to somewhere between $600 and $800 million, according to different sources.) The Nuclear Regulatory Commission (NRC) estimated that a worst-case nuclear accident might cost $600 billion; others say it might cost trillions of dollars.

Bush Administration Plans

In the mass media discussions of the Bush administration initiative to revive the nuclear industry, problems with waste disposal and the high cost of nuclear power plants have been widely discussed, but I have seen no editorial opinion or news columns about the likelihood of another accident, or any discussion of the Price-Anderson act. The Administration's policy paper recommends "legislation to extend the Price-Anderson Act" beyond 2002, but it does not describe the act or explain why the industry cannot afford insurance.

The policy paper made eight recommendations regarding nuclear power, including extension of the act. The other recommendations are wooly—they are unspecific and they do not address the major technical and financial difficulties the industry faces. One is, "Encourage the Nuclear Regulatory Commission (NRC) to ensure that safety and environmental protection are high priorities as they prepare to evaluate and expedite applications for licensing new advanced-technology nuclear reactors." Yet there is no discussion of government research funding for radically new, safer, or scaled-down designs such as pebble bed reactors. The industry is unlikely to finance new development on its own. The other recommendations are vague: "Encourage the NRC to facilitate efforts by utilities to expand nuclear energy generation in the United States by uprating existing nuclear plants safely." The utilities do not appear to be making any efforts to expand generation. After the administration began talking about this, a few utilities launched trial balloons. Georgia Power hinted it might want to build a second plant at a site designed for four plants.

A Closer Look at Some Major Accidents in the U.S.

Let us have a closer look at some of the serious accidents that have occurred in the U.S. They were caused by astonishingly bad engineering, incompetent management, and poorly trained operators. Looking at these accidents in isolation, one might get the impression that U.S. power reactors are run by idiots in the happy-go-lucky style portrayed in the "Simpsons" cartoon. That is not a fair assessment. Even critics grant that most operators are professional and law abiding. Still, it only takes one plant to cause a catastrophe. There are 103 operating plants in the U.S., and 437 worldwide.

The first major U.S. accident occurred in 1966 at the 300 MW Enrico Fermi I fast-breeder reactor. Construction on the reactor began in 1956. It finally began operation in 1966, but within a week it suffered a partial meltdown, serious enough that officials considered ordering an evacuation of Detroit, forty miles away. The plant was rebuilt, but it then suffered a serious fire from leaking sodium coolant—the same kind of accident the Monju breeder reactor experienced in 1995. The plant was patched up again, but it finally shut down for good in 1972, after running less than thirty days over its entire lifetime.

A fire disabled the Browns Ferry reactor in 1975. Reactors have duplicate and triplicate sets of controls and instruments, but at Browns Ferry for some instruments all two or three control wires ran down the same hallway. A twenty-year-old electrician's assistant was looking for an air leak by holding up a lit candle. He accidentally set fire to wire insulation. The fire burned for six hours, destroying controls and instruments. Smoke filled the control room, the reactor cooling systems were disrupted, and the electricity to some of the controls was cut off. The reactor may have come close to a meltdown. Experts disagree today, but during the accident there was panic in the control room. The built-in fire suppression system in the plant had been disabled intentionally during construction, and it took a while to return it to service because no one could find a large screwdriver. After it was returned to service, the fire suppression system did not work, and the only dry chemical extinguisher in the building had a broken nozzle. The local fire department was finally summoned after several hours, but following strict regulations the firemen were not allowed to assist. When they were finally allowed to help, they put out the flames in twenty minutes. The damage cost $240 million, and the reactor was out of service for a year and a half while it was repaired.

Prior to 1979, many incidents might have escalated into severe accidents, but the industry was lucky, and damage was usually prevented. Nuclear power plants were more fragile than the public was led to believe. In March 1978, an operator was replacing a burned out lightbulb in the control panel at Rancho Seco. He accidentally dropped the bulb into the panel. It shorted out connections and disabled the power supplies to most of the control panel (not the reactor itself), including the controls to the main feedwater system, which began to malfunction. Automated equipment designed to prevent damage during feedwater interruptions failed to turn on because the control system was disabled. The human operators could not determine conditions in the reactor, or control it. Fortunately, an autonomous emergency cooling water system came on. After an hour and nine minutes operators were able to restore power to the control panel, and reacquire control over the reactor.

In September 1977, at the Davis-Besse reactor, the main feedwater system failed. This caused an automatic reactor shutdown, and a brief surge in feedwater pressure. The pressure release valve opened. It was supposed to shut after ten seconds, but a missing electric relay caused it to stay open, draining 220 gallons of cooling water from the reactor vessel every minute. There was no indicator light in the control room to warn the operators that the valve was open, and they did not notice the water was pouring into a holding tank. There were no instruments in the control room showing how much water was in the reactor vessel. The operators were trained to determine this indirectly, by looking at a second tank attached to the vessel, called the pressurizer. However, this method did not work correctly with the valve jammed open. Based on the false reading from the pressurizer-water-level-indicator, the operators turned off the emergency cooling pumps. They knew that too much cooling water can be as dangerous as not enough. Twenty-two minutes into the accident, the operators discovered the valve was open, and they stopped the flow of water.

Because the reactor was running at only 9% power, serious

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rate. The WNA is more sympathetic to the operators than most. It says they turned off the emergency pump because "their training told them to do all they could to keep the pressurizer from filling with water. If it filled, they could not control pressure in the cooling system and it might rupture. . ." The WNA denies that TMI came close to a full meltdown, but experts have honest disagreements about that issue. It downplays the likelihood of a catastrophe even if a full meltdown occurs.

> . . . The accident fostered better understanding of fuel melting, including improbability of a "China Syndrome" meltdown breaching the reactor vessel or the containment building. . .

The Association does not explain why the industry demands limited liability with the Price-Anderson act, even though a meltdown is "improbable." The U.S. based Nuclear Energy Institute has a more propagandistic tone. In "Three Mile Island: Myths and Facts" it makes the startling claim that "scientists hypothesized that a portion of the plant's core melted and flowed to the bottom of the reactor where it solidified and protected the vessel." This may be true, but the vessel was not designed for that purpose, and such unplanned features cannot be depended upon. Similar fortuitous performance of the booster rocket o-rings in the Space Shuttle prevented a complete burn-through on several occasions before the Challenger explosion. The flames were never supposed to reach the o-rings in the first place, and the fact that the o-rings held up surprisingly well was no cause to celebrate.

All sources agree on the basic facts about the accidents at Browns Ferry and TMI. They differ mainly in assigning blame. The NRC blames the operators, B&W, the engineering firm that designed the control room, and the utility company. B&W blames the operators and the utility. The utility blamed the NRC, filing suit against the government because regulations were too slack, although before the accident utility companies complained to the Congress that government regulations were too onerous. Recently, the Bush administration, presumably acting on behalf of the industry, has been pressing Congress to "streamline" regulations and reduce oversight. The one person who was clearly not to blame was Creswell, the NRC engineer who worked for months to try to prevent a second Davis-Besse accident. After TMI he was awarded $4,000 for diligence, but away from the limelight the harassment continued, and in 1980 he resigned from the NRC. The NRC officials who were directly responsible for suppressing his report and approving the TMI design were given $10,000 rewards.

The TMI-2 reactor was decontaminated in a fourteen-year project. All radioactive debris has been removed from the site. The reactor has been placed in "Post-Defuelling Monitored Storage (Safstor)," where it will remain until the operating license of Unit 1 expires in 2014, when both units will be decommissioned and dismantled. To date, seventy commercial power reactors have been retired worldwide, and a few have been dismantled and removed.

A Note on Computers

In 1979, TMI, like all nuclear plants, had extensive automation. This was mainly in the form of special-purpose controls, such as the secondary cooling system that turned on automatically, which would have prevented the accident had the operators not disabled it. What TMI lacked was a powerful, flexible general purpose computer in the control room. Daniel Ford wrote that the utility selected a small, inadequate computer in order to save money, because "people are cheaper than computers." I doubt it. As it happens, in 1979 I was programming a small minicomputer to monitor telephone equipment in real time and report conditions. It could process about as much data as the TMI control room instruments generated (3,000 events every one to five minutes). However small the TMI computer was, a junior programmer could have made it do the tasks described above, such as checking valve positions or recognizing that a change in the holding tank water level is an important event that should be communicated to the operators immediately. This would have cost practically nothing. I expect the utility company and reactor engineers simply never thought to do it. Even engineers working in high technology were not used to computers back then; they did not think about how to take advantage of them. Many jobs were still done by hand that could have been automated easily, on computers already running with capacity to spare.

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Yomiuri Shimbun, for coverage of the nuclear industry in Japan and recent opposition to the use of MOX fuel. ■■■

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valves, cutting off emergency feedwater pumps. The pumps were spinning, but the cooling water was not going anywhere. It took the operators a while to find this problem because the instruments were inadequate and confusing. There was no flowmeter showing zero gallons actually flowing from the pumps, and no computer check to make sure the valves were in the correct position. The valve indicator lights were too far from the operator console to be read easily, and one was covered with a paper tag. When the operators went over to have a closer look, they were horrified to find the valves were closed. They opened the valves immediately. They assumed this would fix the strange behavior, since they still did not realize that the pressure relief valve was jammed open. The problems did seem to subside for a while, but later the reactor once again showed signs it was not cooling correctly, as well as false indications that the nuclear reaction was restarting. The operators performed emergency boration to quench a chain reaction. The false indications were caused by steam and tremendous heat, which was building up inside the reactor vessel, where the core was being destroyed in a loss-of-coolant melt-down accident.

After the accident, B&W blamed the operators for not knowing the relief valve was stuck open. B&W said the operators should have looked at the temperature of the pipe attached to the relief valve, and the water level of the holding tank the pipe led to. They would have seen the pipe was hot from the water gushing out, and the water level was rising. In fact, the operators did check these numbers twice in the first fifteen minutes of the accident, although it was difficult for them to do so. There were only three harried operators. To read the water level one of them had to leave the operator console, which was against government regulations in an emergency, and look behind a panel on the other side of the room. The tank water level was shown with a single number, with no flowmeter, pen recorder graph, or other indication that the water level was increasing. The operators glanced at the water level twice, but apparently they did not write down the first reading and compare it to the second. To find the temperature, an operator had to leave the control room and type a command on a computer in another part of the building. The computer reported that the outlet temperature was 280˚F, when it was actually over 600˚. For some unknown reason the computer was programmed to report a maximum value of 280˚, no matter how hot the water became. The tank water level and high pipe temperature seemed reasonable. The operators knew there should be water in the tank, because they thought the valve had opened normally for ten seconds at the beginning of the accident, and they knew the valve had been leaking slightly for months. They assumed the pipe had cooled down after the ten second burst, but it remained warm from the slow leak.

Standard B&W reactors had no means of measuring the temperature inside the reactor vessel. As it happened, this particular reactor had thermocouples installed a foot above the uranium core, placed there by B&W engineers who wanted to study field performance. The operators began to suspect that the core was overheating. They ordered a computer to report the thermocouple temperature readings. The computer responded with a line of question marks: "??????" It was programmed to report only normal operating temperatures between 200 and 600˚F; outside of that range it printed question marks. The thermocouples could measure much higher temperatures. Later that day, engineers tapped into the wire from a thermocouple to the computer. They read the voltage with meters, and determined that the temperature was 2,300˚F. The plant manager and NRC officials did not believe it. The technicians confirmed the reading with another instrument in the presence of the plant manager. They continued to take measurements for a while, until radiation alarms forced them to evacuate. One of them later said, "I think the general consensus throughout the whole first day was, number one, nobody really knew what was actually happening; number two, some that had an inkling of what was happening didn't really want to believe what was going on." The temperature data was not reported to the NRC headquarters or to experts outside the plant until weeks after the accident.

The control room was equipped with a minicomputer which monitored 3,000 instrument readings. It compared them to the expected normal range of values, and printed a message when a reading went out of range. It was not programmed to analyze, prioritize, or respond to the data. The computer was fast enough to keep up with the flow of data, but it was equipped with an obsolete, cheap, and excessively slow printer which printed fourteen messages per minute. During a normal reactor shut down, messages would pile up in memory, and the log would not finish printing until an hour after the reactor was off. During the accident, thousands of abnormal messages were generated. The computer soon fell behind, sometimes lagging two and a half hours. Apparently, no one thought to bring in a faster printer. The computer did no prioritizing. It might lumber along printing a hundred unusual but inconsequential readings before getting around to report that the radiation alarms were a thousand times higher than normal. The only way to bring the computer up to date to see current conditions and the latest messages was to reset the machine and purge the memory, erasing all backed-up messages. This had to be done several times, losing critical data. Even the smallest computers of this era could have done more. With a rudimentary program and database the computer could have printed high priority alarm messages such as: "Warning: emergency feedwater valves shut. Should be open" or "Pressure relief valve holding tank water level increasing 220 GPM."

Finally, two hours and twenty minutes after the accident began, the supervisor for the morning shift arrived and determined that the valve was stuck open. He stopped the flow, but it was too late. The core was already gravely damaged, although the operators still had no way of knowing that. Later, they deliberately drained more water out of the vessel, because they did not realize that lowering the pressure would cause more water inside it to flash into steam, again uncovering the core. They were not trained to read steam tables, and apparently they did not understand some basic principles of pressure, heat, and steam. These principles have nothing to do with nuclear energy. They have been common knowledge to steam engine operators since the mid-nineteenth century. The operators did their best, but they were high school graduates, not trained

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Returning to Issue No. 35, we have Rothwell's report of the Second Annual Japan Cold Fusion Society Conference. It is there stated:

> Heavy water electrolyte always contains some light water (hydrogen) contamination, which hampers the cold fusion effect with palladium. Both deuterium and hydrogen are forced into the cathode. They gradually leak out, but the cathode preferentially retains hydrogen . . .

This writer's reaction mechanism demands the presence of hydrogen and it is present as a matter of fact. One must doubt there is any evidence of the production of excess heat under conditions where one can state with confidence that hydrogen has been excluded because the exclusion of ordinary hydrogen from heavy water and from the reaction materials is difficult.

One should not confuse the necessary presence of hydrogen with a system which functions in the absence of deuterium, for both hydrogen and deuterium are necessary to this writer's mechanism for the production of helium-4 in the aqueous cold fusion system. Systems which function to produce excess heat in the absence of deuterium are certainly possible, but these may require the more vigorous electrical pressure which this writer employs in the gas phase using an electron beam apparatus.

Rothwell in his report on two cold fusion conferences in the Washington, D.C. area says: "Some people have suggested the boron takes part in the nuclear reaction. Miles does not agree."

This writer has insisted that boron, which contains a negatively-terminated neutron in his vortex theory, functions through that negative terminal group to participate in the cold fusion reaction. This negative terminal group (which is also present but not easily available on the palladium nucleus) was thought to react with the deuterium proton to form a chain of one proton and two neutrons which is ejected as a tritium nucleus, but it now seems more likely for helium-4 to form when fractional hydrogen is present, as will be illustrated hereinafter.

This writer's electron beam experiments suggest that this negatively terminated neutron functions to remove energy from hydrogen's electron (via its proton) and this energy removal causes normal hydrogen to collapse and form fractional hydrogen. The formation of fractional hydrogen proceeds more easily than the formation of a tritium side chain, as evidenced by the large amounts of heat released in this writer's gas-phase electron beam work. However, the small number of such events taking place in the cold fusion system will not release very much total heat because only about 54 electron volts of energy are usually involved in each event. In the cold fusion reaction in aqueous medium there is little hydrogen around and the electrical pressures are small, so only a small amount of fractional hydrogen is formed (slowly at first). The result is a small number of events producing little total heat. On the other hand, when helium-4 is formed, far more energy is released per event, so excess heat becomes measurable.

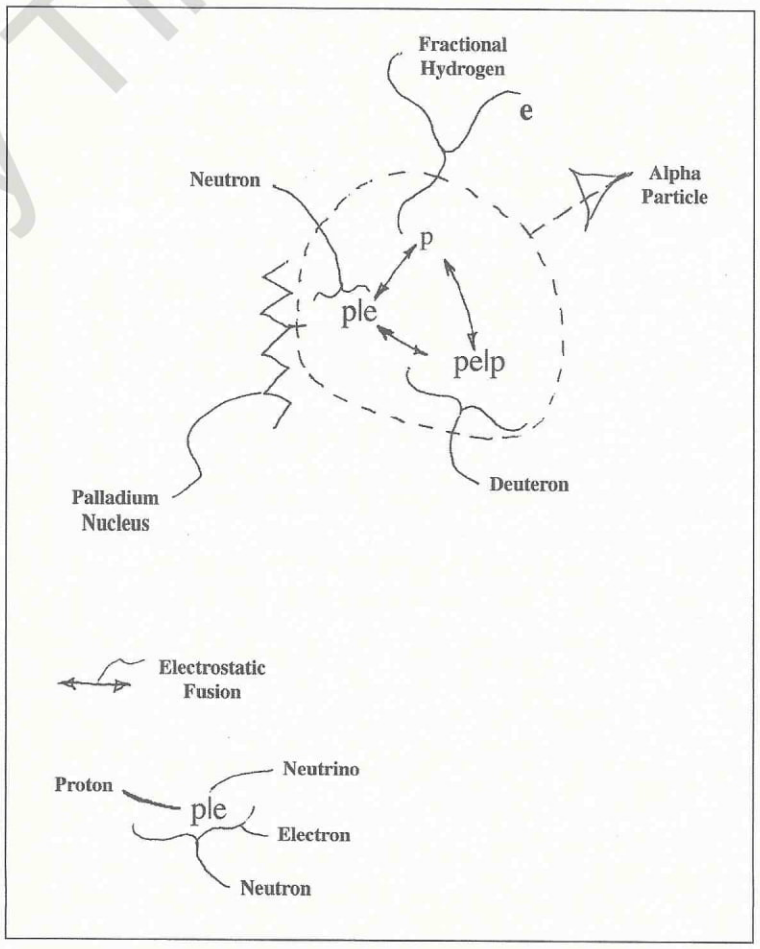
Is there any indication of the formation of a lower isotope of palladium, for this is what is initially formed when an extra neutron is pulled away in this writer's mechanism?

Rothwell discusses the possibility of transmutation and even fission taking place, as well as the possibility of isotope shifts in materials found at the surface of the cathode. The problem with this with respect to this writer's reaction mechanism is that isotope shifts in the palladium will be hard to detect because there is so much palladium present and so little of it becomes involved in the formation of helium-4. On the other hand, when a fractional hydrogen proton is captured by the palladium nucleus all sorts of fission events might be triggered, and there are many possibilities. Rothwell does not discuss what happened to the boron. Release of helium-4 in an alpha emission event is known to release considerable energy; it does so without neutron emission, and that helium-4 will more likely come from the formation of boron-10.

One must remember that deuterium-deuterium fusion does not induce the fission of some other element which may be present nearby. In contrast, this writer's suggested reaction mechanism involves fusion of a proton with a neutron (which may be on the palladium nucleus), and it is at least possible for this to cause the palladium nucleus to fission.

One problem with the use of palladium catalysis is that palladium is rare and prohibitively expensive. If the palladium is consumed by the reaction, then the fuel for cold fusion is much too rare and expensive to provide a viable source of large amounts of energy.

Rothwell points out that in the absence of boron, palla-



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soil and the discharge canal . . . Management was aware of these problems but did not take effective steps to resolve them." The investigation also revealed that in the 1980s and 1990s the plant operators gave away contaminated soil, asphalt, and hundreds of concrete blocks to local residents. In 1989, contaminated soil from the plant was transported to the playground of a day-care center operated by the spouse of a plant employee.

Serious problems and abuses are still reported. I do not have enough engineering knowledge or inside information to judge whether these problems are severe enough to cause a second TMI or Connecticut Yankee, but anyone can see they may cost a lot of money some day, they could easily be avoided, and if they are published in the mass media the public will be upset. The reader will get a sense of where things stand from this example of bureaucratic prose from the NCR:

http://www.nrc.gov/NRC/COMMISSION/SECYS/1997-042scy.html

> In December 1995, the staff received allegations that the licensee for Maine Yankee Atomic Power Station had knowingly performed inadequate analysts of the emergency core cooling system (ECCS) and the containment in support of two power uprate amendments. . . .
>
> The NRC staff determined that plant-specific application of RELAP5YA for Maine Yankee did not fully conform to the requirements of 10 CFR 50.46 and 10 CFR 50 Appendix K, nor had it been applied in a manner conforming to the conditions specified in the staff's SER, as necessary for NRC acceptance of the use of RELAP5YA for small-break loss-of-coolant accident (SBLOCA) analyses for Maine Yankee. As a result, the staff concluded that the SBLOCA portion of the ECCS analyses performed for Maine Yankee Cycle 15 did not conform to the requirements of 10 CFR 50.46.
>
> . . . The assessment indicated a need for improved consistency and uniformity in the submittal and more formal staff guidance in the review of code applications. In addition, staff verification of licensee and vendor implementation should be improved.

NRC Plant Status Reports from May 2001 include twelve ordinary status messages, such as "REFUELING," and six trouble reports, showing that valves and plumbing are still the main source of problems:

> Nine Mile Point 2, 85% Power (Meaning the reactor was running at 85% of capacity), holding power at this level due to a recirculation flow control valve problem; Salem 1, 15% Power, holding power at this level with the unit off line after recovering from a reactor trip on ON 05/22/01 (Refer to event #38021) (A "reactor trip" is an unplanned, abrupt reactor shutdown.); Three Mile Island 1, 75% Power, holding power at this level to observe 'A' main transformer gases; Kewaunee 1, 96% Power, maximum power level due to plugged steam generator tubes; Point Beach 1, 85% Power, increasing power after decreasing to 80% for faculitate condensate cooler cleaning due to fouling.

An incompetent surgeon at a major hospital may kill scores of patients. An inept pilot or air traffic controller may kill hundreds of passengers. But this damage is nothing compared to the potential harm a fool running a nuclear plant may someday cause. A nuclear plant is an amplifier. It multiplies mankind's power, and it amplifies a fool's ability to commit mayhem to superhuman levels. No other technology except nuclear weapons puts so much power in the hands of so few people.

How Does Cold Fusion Compare?

The more you learn about the hazards and complexities of nuclear fission power, coal, and other conventional energy, the better cold fusion looks. Based on what we have learned about cold fusion so far, we can predict with confidence that if it can be controlled it will be much cheaper and less polluting than any other source of energy, including fission and wind power. Most cold fusion theorists agree that in common with a fission power plant, the cold fusion reaction cannot go out of control to cause a massive, nuclear explosion. The metal substrate would melt or vaporize long before the reaction had time to do that. Cold fusion is not a chain reaction (like fission), although it does produce heat that can cause positive feedback (like combustion). Most theorists and experimentalists expect that we can learn to control the reaction to prevent any dangerous radiation. This means cold fusion reactors will be made small enough to power houses, cars, and eventually wristwatches, light bulbs, and pacemakers, thus eliminating the power distribution network. The U.S. could generate far more electricity from wind than it now consumes, but this would require a massive infrastructure of towers, turbines, and power lines or hydrogen pipelines. It would take roughly 750,000 wind turbines to power the entire country, or roughly as many tons of heavy equipment as our fleet of 4.1 million commercial trucks. Towers would be visible everywhere you turned, and many people feel they are an unsightly blight on the landscape. Manufacturing and maintaining this equipment will cause pollution. Cold fusion has much higher energy density than wind, so it would take roughly three times less generator equipment, and no distribution network at all. Cold fusion generators would be co-generators, supplying heat (or thermally driven air conditioning) as well as electricity, so they would probably not take up more space or materials than we already devote to home heating equipment.

Epilog, and a Note on Sources

The main source for this article is a superb book by Daniel Ford, *Three Mile Island: Thirty Minutes to Meltdown*. Ford is the former executive director of the Union of Concerned Scientists, an organization opposed to nuclear power. The book is based on original sources, such as the Kemeny Commission, the NRC special inquiry group, and the Senate investigation.

Since my primary source comes from an antinuclear organization, I thought it would be fair to crosscheck Ford's claims and base the rest of the essay on sources that may be biased in favor of nuclear power, such as the DOE, the NRC, the Bush Administration energy policy position paper, and industry organizations such as the World Nuclear Association (WNA), headquartered in Britain. The descriptions of the TMI accident published by most of these organizations seem fair and accu-

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ECLECTIC OBSERVER

Compiled by Eugene Mallove

Faith-Based Physics and bin Laden

The horrific atrocity of the terrorist attack on New York's World Trade Center and the Pentagon was fresh on my mind as I examined a clipping, sent to me by an *IE* subscriber, from "Parade," an American Sunday newspaper supplement. The *back* of the clipping, which was published *before* the attacks, carried an ironic piece of news: "FBI Tries to Smoke Out Osama," which mentions that the FBI's reward money for Osama bin Laden is advertised in Arabic ("Osama bin Laden, Up to $500,000 Reward") near a photo of the villain on matchbook covers throughout Pakistan! The FBI's faith in the effectiveness of its ad campaign was sadly misplaced, as the events of September 11 showed all too well.

On the reverse side of this amazingly synchronistic clipping, the subscriber had circled an item from a recent "Ask Marilyn" column, a response to a Missouri reader's query: "Is there any simple way for the average person to grasp the theory of relativity?" Marilyn Vos Savant replied, in part: "In my opinion no. . .without being highly educated in physics, we can only read summaries of the theory, accept the points on faith and then successfully repeat what we've learned to others. . .All of us are capable of understanding far more than we do; we just don't have the time to educate ourselves in every field."

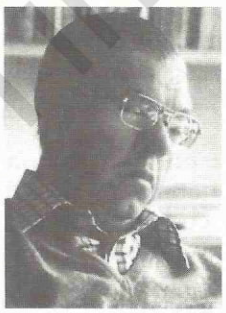
The subscriber aptly notated this dictum as "faith-based" science. Indeed, in the context of our two recent *Infinite Energy* issues of Einstein criticism, I was struck by how well "faith-based" describes so much that is wrong with modern physics. The physics high priests have convinced lay-people that they are not to investigate or challenge accepted theories, such as Relativity. And we are well aware that few who enter the physics profession "have the time" to explore opposing views to accepted theories (of fusion, relativity, or anything else)—just as the lay audience that "Marilyn" advised. Each new generation of physicists and their groupies is encouraged to "have faith" that all is well with the foundations of physics, especially Relativity.

Bubbling Shrimp

Laboratory settings are not the only places where popping sounds from cavitation bubbles can be heard. For the past few years, scientists have been observing certain marine crustaceans, shrimp of some genera that inhabit tropical waters, which produce snapping sounds due to the collapse of cavitation bubbles that they make with the slicing of their claws. In a laboratory setting, cavitation is produced with ultrasound beamed into liquids. The shrimp apparently use their claw-generated sounds to locate mates, immobilize prey, and joust with rivals.

A recent report in *Nature* (October 4) now confirms that those cavitating shrimp are also producing sonoluminescence—light emissions from the bubbles, pulses which have challenged theorists for years. The late Nobel Laureate Julian Schwinger proposed an analogy between cold fusion and sonoluminescence (see *IE*, No. 24). Scientists from the Netherlands used photomultiplier tubes to gather the first evidence ever of biologically-created sonoluminescence. The temperatures at the centers of cavitating bubbles that produce the light have been variously estimated at tens of thousands of degrees C—not enough to cause "hot fusion" of hydrogen isotopes. On the other hand, in view of the ability of cavitation at the surfaces of metals to create excess heat and other cold fusion phenomena, one might imagine the possibility of such low-energy nuclear reactions being triggered by energetic organisms like the snapping shrimp.

Sir Fred Hoyle Dies, Noted Cosmology and Origin of Life Heretic



On August 20, 2001, the world lost one of its most articulate and prominent critics of Big Bang cosmology. He was 86. Ironically, it was Fred Hoyle who in the late 1950s coined the term "Big Bang," in mocking reference to the idea that "in the beginning" the universe had expanded from a primeval "atom" of matter. He and his colleagues Hermann Bondi and Thomas Gold beginning in 1948, and most intensely through the 1950s and early 1960s, championed the Steady State Theory of cosmology. In that theory, matter was said to be *continuously* created *de novo* in the far reaches of space. Hoyle never gave up the basic idea of a steady state cosmology, even in the face of the Big Bang's ascendancy since the mid-1960s with the discovery of so-called cosmic background (microwave) radiation. The theme of Hoyle's latest book, *A Different Approach to Cosmology* (Cambridge University Press, 2000), co-authored with Geoffrey Burbidge and Jayant V. Narlikar, is that ". . .dependence on the hot big bang model has led to an unwarranted rejection of alternative cosmological models." They dub their new cosmological theory "Quasi-Steady State," and claim that it is consistent with all astronomical observations.

Sir John Maddox, emeritus editor of *Nature* and no sympathizer with scientific heresy, in an obituary (*Nature*, September 20, p. 270) termed Hoyle "the most imaginative of men, a kind of Leonardo [Da Vinci]." Maddox wrote: "My own conviction is that Hoyle's skepticism [of the Big Bang] was well founded. But it is too soon to tell how the Big Bang will be replaced by some other cosmology." Maddox recounts that he asked one of Hoyle's former colleagues whether he had read *A Different Approach to Cosmology*. The colleague's reply,

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The Mechanism of COLD FUSION

Arnold G. Gulko*

Several months ago, *Infinite Energy* editor Gene Mallove suggested to this writer that the production of helium-4 was the key to the fusion reaction which powers cold fusion, indicating this helium-4 was being attributed to the product of deuterium-deuterium fusion. This writer insisted deuterium-deuterium fusion could not power cold fusion and proceeded to explain how fractional hydrogen produced at the cathode could interact with an extra neutron on the palladium or boron nucleus, on the one hand, and with deuterium, on the other hand, to produce helium-4.

These reactions involving fractional hydrogen modify the palladium nucleus to cause it to emit an alpha particle, usually directly, but possibly as part of a proton capture—an induced fusion event. Modification is a slow process, because fractional hydrogen is an essential agent which must first be produced from normal hydrogen. This is why cold fusion does not produce excess heat immediately.

Accordingly, it was and is this writer's opinion that the production of fractional hydrogen is the key to unlocking the excess heat which characterizes cold fusion. This writer's opinion should be carefully considered since, in 1989, he immediately perceived (based on his vortex theory) that certain elements, and he singled out boron as the preferred element, would improve the cold fusion reaction, and he subsequently used a palladium cathode containing boron to produce fractional hydrogen using an electron beam apparatus in a gas-phase system. (See *IE* No. 34.)

Issue No. 35 of *Infinite Energy* contains diverse information which bears on the issue under consideration. First, Issue No. 35 corroborates Mallove's view that the production of helium-4 provides the energy which generates the excess heat in the aqueous electrolysis reaction which has become known as cold fusion. Jed Rothwell states on page 11:

> McKubre proved once and for all that palladium cold fusion produces helium. Iwamura has proved it also produces transmutation and fission. I have no idea how to reconcile these two findings.

We thus have two inconsistent findings, which confirms the need to understand how the helium is produced. The answer to this question is needed because it might enable one to upgrade the cold fusion system to where it might be a useful source of energy instead of a scientific curiosity.

From the standpoint of McKubre's thinking, Rothwell states he believes, "It is definitely 'fusion; a D-D reaction, resulting in helium, and occasionally tritium.'"

Second, Issue No. 35 corroborates the view that boron improves the cold fusion system. Rothwell, in reporting the ANS conference in Washington, D.C., indicates Melvin Miles ". . . spoke mainly about palladium boron cathodes. . . Miles achieved 100% reproducible excess heat with these cathodes."

The failure of cold fusion to be "reproducible" importantly contributed to the refusal of mainstream physics to accept its reality, and we now have clear proof that this writer's prediction based on his vortex theory (memorialized in his rejected patent application filed in 1989) was able to solve the problem. In contrast, Issue No. 35 does not explain how boron works.

The fusion of deuterium with itself is a well-known reaction, and it normally produces large numbers of neutrons as well as very little helium-4. When helium-4 is produced in known fusion, a high energy gamma-ray is released. But neutrons are not produced in large number, even when the cold fusion reaction is producing excess heat, and the cold fusion electrolysis reactions are also not a strong source of gamma-radiation.

We are here concerned with what routinely produces the significant amounts of helium-4 which have been found, sometimes together with tritium. If cold fusion produced neutrons and/or gamma radiation, as characterizes the known deuterium-deuterium fusion, then Fleischmann and Pons would have received a fatal dose thereof as they watched their experiments.

One reason physicists have great trouble accepting cold fusion is because it has been attributed to deuterium-deuterium fusion. This conclusion was first asserted in 1989, and it is continued in Issue No. 35, as noted above. But this conclusion is inconsistent with extensive experience with deuterium fusion, as has been discussed.

It is one thing when physicists get hung up with their inability to consider results which don't fit their preconceived notions, for it is unscientific and wrong for anyone to insist any given theory must be correct. It is quite another thing for physicists to insist that their consistently-obtained experimental results should be respected.

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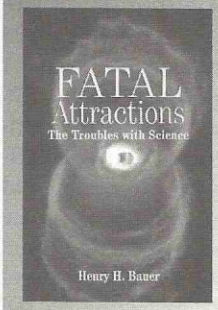
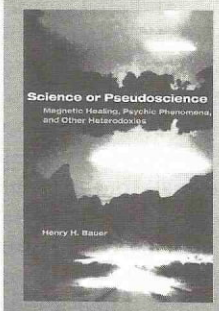
Book Reviews



Fatal Attractions: The Troubles with Science

by Henry H. Bauer
ISBN 1-931044-28-7
$14.95 Paperback, 237 pp.
Paraview Press, 2001



Science or Pseudoscience: Magnetic Healing, Psychic Phenomena, and Other Heterodoxies

by Henry H. Bauer
ISBN 0-252-02601-2
$29.95 Hardcover, 275 pp.
University of Illinois Press, 2001

Review by Eugene F. Mallove

Two recent books by Professor Henry Bauer are best reviewed together, since they cover roughly the same intellectual territory—the sociology of science, with particular reference to the field of "anomalistics" (or "pseudoscience" in more pejorative terms and usage by "skeptics"). *Fatal Attractions* is the more general discussion of the sociology of science, whereas *Science or Pseudoscience* emphasizes the not always clear separation between anomalistics and mainstream science—in Bauer's apt terminology, the search for the *unknown unknown* versus the *known unknown*. It is clear to this reviewer that the complex term *pseudoscience*, as with *beauty*, will continue to be "in the eye of the beholder."

It must be said that these intellectually rewarding and generally well-written books have significant, though not fatal, flaws: the overall treatment of cold fusion and the work of Wilhelm Reich most prominently (more on this later). The books' main virtues are to stimulate new kinds of thinking about definitions, methods, and social relations in and around the sciences. A spectrum of readers from hard-line "debunkers" to "supporters" of this or that scientific anomaly will find these works congenial.

Henry Bauer writes from a position of considerable authority, having been a practicing electrochemist as well as the Dean of Arts and Sciences at Virginia Polytechnic Institute. He is the author of several noted books on anomalistics: *Beyond Velikovksy: The History of a Public Controversy* (1984); *The Enigma of Loch Ness: Making Sense of Mystery* (1986); *To Rise Above Principle: The Memoirs of an Unreconstructed Dean* (under the pseudonym Josef Martin, 1988); and *Scientific Literacy and the Myth of the Scientific Method* (1992). This reviewer has known Henry since the mid-1990s, when I became a member of the Society for Scientific Exploration, a Ph.D.-laden organization which since the early 1980s has published one of the best journals on general anomalistics in the world, the quarterly *Journal of Scientific Exploration*. *JSE* continues under Bauer's able editorship, which began several issues ago. I recommend *JSE* (www.scientificexploration.org) to *Infinite Energy* readers who wish to broaden their horizons in anomalistics.

In the introduction to *Fatal Attraction*, Bauer identifies the central dilemma of modern science: "In a nutshell, the trouble is that science, in large part through its very success, has become a great deal more than our storehouse of knowledge about the mechanics of the world. Science has become our arbiter of truth. It has become a universal role model for how to acquire knowledge. Science has even become a surrogate religion. As a consequence, science now occupies an impossibly demanding cultural role, and it is in the impossible demands of that cultural role that the troubles reside." He quickly gets to the key social conundrum about science and spends the rest of the book exploring it: "There is a fundamental lack of agreement over how science actually works, how reliable its knowledge is, how any given bit of science can best be appraised, and how we can judge when science is able to supply a specific recipe for something we want done. This lack of fundamental understanding is a critical matter and it is critical for one simple reason—science is inescapable in modern life. Whether we are obsessed by it or whether we try to ignore it, science is pervasive. It behooves us to make sense of it now."

The more breezy work, *Fatal Attraction*, would have been improved with a bibliography of references and an index; the more academic *Science and Pseudoscience* has these. The latter's twenty-five-page list of references is a superb resource for explorers in this area, from which I learned about many new rivulets of information. There is much overlap in coverage and actual text from book to book, but these nicely complement one another.

As one might expect from an attempt to cover a vast area of knowledge from extremely diverse fields, errors of fact and assessment occasionally emerge. As an example, a thread runs through that accepts that Einstein's relativity theories are on solid footing; Bauer cites the alleged experimental confirmation of (general) relativity by the degree of light-bending by gravitational fields (*Fatal Attraction*). He should have been more cautious on points like that, given the several relativity critics who have expounded on the pages of *JSE*. *Infinite Energy's* recent Einstein issues may encourage a more balanced assessment in future editions (see his letter in this issue, p. 4). At another point he writes, "there is no serious group of alchemists opposing chemists" (*Fatal Attraction*)—indeed, certainly not "ancient alchemists," but what about the alchemy-like low-energy nuclear reactions from the cold fusion field? He says there is no "alternative" thermodynamics (*Fatal Attraction*). Not true, as a handful of thermodynamics critics have demonstrated, in theory and experiment (not to forget the thermodynamics-breaking work of W. Reich). Paradoxically, some of these lapses into unwise "certainty" by the author are excellent examples of the very point he makes about the difficulty of defining the boundaries of the known!

Bauer pioneers a dichotomy of "maps" and "stories" to

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dium is frequently ineffective to cause the production of excess heat. This writer has been able to collapse hydrogen using a palladium cathode containing boron, and has also been able to replace the palladium with other material, such as aluminum and aluminum-beryllium mixtures. These other less expensive catalysts work well to collapse hydrogen, so they might also work in the aqueous electrolysis cold fusion reaction. These other elements were suggested in 1989, and they should be tested.

From the standpoint of having an electron-terminated extra neutron, magnesium is like beryllium and it can be used in place of or in addition to boron or beryllium. This magnesium might then be consumed by reaction. Rothwell states in Issue No. 35: "Magnesium, for example, appears early in the run, increases, and then it begins to decrease."

This writer's suggested reaction mechanism is illustrated in the accompanying drawing, which shows a fractional hydrogen atom interacting with the negative terminal group on a neutron carried by an element in the cathode (here identified as palladium) and also with a deuteron (a deuterium nucleus provided by electrolysis). The resulting group containing two protons and two neutrons is shown by dotted lines being ejected as an alpha particle. This alpha particle is slowed, which heats the cathode and the surrounding water, and it quickly captures electrons to form helium-4. Unlike neutrons and gamma-rays, helium cannot escape the reaction chamber.

It is lastly noted that fractional hydrogen should be expected to have a greater capacity to participate in a fusion event because of its small size.

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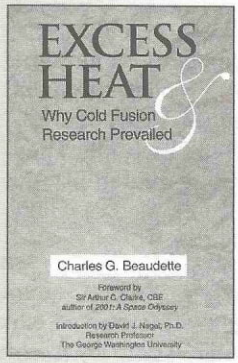

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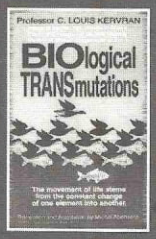

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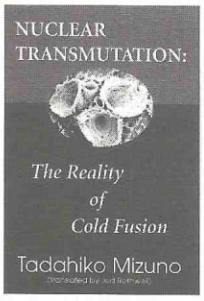

Hardcover, 1998

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by Dr. Tadahiko Mizuno

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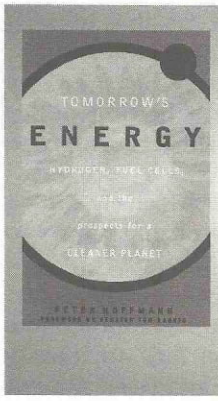
and spirit of these books, I disagree with Henry Bauer's generalization, "The amazing thing is that science as a whole, communally, collectively, has been able to transcend human fallibility to such a high degree in so many directions." (*Fatal Attraction*) He adds, ". . .the overall reliability of agreed-upon scientific knowledge is well guarded by the conservative, deliberate manner in which consensus forms in the scientific community." (*Fatal Attraction*) I am much less impressed with the integrity and "cosmology" of contemporary scientific "consensus." I believe that what passes today for certainty in physics, chemistry, and biology will eventually be recognized as fatally flawed at fundamental levels. That a revolution in basic scientific understanding will have been so long delayed is a tribute to the fallibility of human institutions, especially an arrogant affinity for power and position in an enterprise, science, whose revolutionary history should engender extreme humility. The arrogance of power *dominates* the culture of science today, elevating evident fictions to exalted "facts." Bauer should have emphasized a view that he did make at another point in his narrative: "Science inevitably tempts its practitioners to scientism, scientific hubris, dogmatic arrogance, childish naivete. Though many individual scientists have successfully resisted those temptations, one is hindered from understanding the social interactions of science and scientists if one is not aware of this tendency." (*Fatal Attraction*) What Henry Bauer regards as a "tendency," I believe to be a disease epidemic in the house of modern science.



Tomorrow's Energy: Hydrogen, Fuel Cells, and the Prospects for a Cleaner Planet

by Peter Hoffmann
ISBN 0-262-08295-0
$32.95 Hardcover, 289 pp.
MIT Press, 2001

Review by Jon Norris

Since the time of Jules Verne, hydrogen has been the Holy Grail for many a dreamer in a clean and abundant energy future. There have been numerous predictions that hydrogen would provide the perfect society with unlimited clean energy. Peter Hoffman gives a good accounting of much of that history in this update of his work as editor of *The Hydrogen Newsletter*.

From a historical look at hydrogen and its discovery, he moves through the last century detailing many different aspects of hydrogen's development—from chemistry and energy use to social and political impact. The book's tone is well-balanced between academic and popular, which I find appropriate.

Hoffman gives an interesting and informative tour of many hydrogen-based projects. He cites relevant data and conveys the determination and strong belief of those in the hydrogen research community that hydrogen is the clean energy source of the future. He discusses the work done on developing methods for handling and using hydrogen, including some theoretical work that was never developed technologically. His presentation is detailed and thorough.

One striking bit of information in the book is the revelation that the Hindenburg disaster was not due primarily to hydrogen! It seems that some dirigibles were coated with a mixture of aluminum and iron compounds that are remarkably similar to solid rocket fuel, and a helium-filled U.S. dirigible suffered exactly the same fate when its coated skin burst into flames. That is important information for the hydrogen community to convey to the general public.

His coverage of the many aspects of hydrogen's use reveals a depth of knowledge and sincere effort at comprehensive research. Since Hoffman seems so well-informed in this field, there are three glaring omissions in his book. The first two, cold fusion and Randell Mills' work, are not mentioned, even in a negative manner. Considering the incredible amount of evidence for cold fusion and Mills' groundbreaking work with hydrogen, that cannot be explained as simple oversight! Much less important work is mentioned, such as the Biopol plastic misadventure (the plastic was hyped, but flopped).

The other serious omission in the very small section on biomass is hemp. Several crops and municipal waste are mentioned as sources of chemical feedstocks and hydrogen/methane gas, but hemp is not discussed. Considering that hemp is arguably the best agricultural candidate to replace petroleum, this is also a major oversight.

A lesser problem is the weight given to the predictive powers of Cesare Marchetti. His determination of a required time span of 100 years for a new technology to replace an old one at the 99% level seems unrealistic. This rule clearly doesn't apply to brand new technology, because virtually any electronic product today quickly sinks that theory. For example, mechanical calculators were replaced by electronic ones in considerably less than 100 years, in roughly twenty years or less. Similar rapid replacement timelines exist for refrigeration and automobiles. I find it more relevant to talk about significant replacement, in contrast to complete replacement.

Hoffman's approach is more that of a reporter than an evangelist. He does not take a strong, polarized stand on issues such as global warming or the political and economic influence of the oil cartels; he reports the opinions of various experts from different sides. I give him credit for asserting that global warming is not a solidly proven scenario. One statement by Hoffman with which I vehemently disagree, however, is that Shell Oil's creation of a hydrogen division is a sign that the oil industry is fraying at the edges. I think that this is simply a large corporation moving into a field to extend its market reach, not a sign of an industry starting to fall apart.

Despite omissions that are important, this is a good book about energy research. The economics of replacing vested infrastructure, the problems of dislodging a ubiquitous mindset, the problems of getting a piece of the energy research pie and of getting serious recognition for radical work are all touched upon with thoughtfulness and minimal bias. I very much wish that Hoffman had included Mills' work and cold fusion. That would have made a good book a great one!

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"Wouldn't waste the time." Maddox comment on that: "The hope must be that civility will break out among Hoyle's enemies now that he is dead." That is pure chutzpah and hypocrisy coming from Maddox, who in the third sentence of the obituary wrote, "He also put his name to much rubbish and was embroiled in controversy for most of his life."

Sir Fred Hoyle and his colleague Professor Chandra Wickramasinghe also challenged conventional conceptions of the origin and evolution of life. They have contended that the seeds of life came from space and continued to modify life on Earth with a perpetual rain of viruses and other organic material—even bacteria. These ideas have appeared in co-authored books: *Lifecloud: The Origin of Life in the Universe*, 1978; *Diseases from Space*, 1979; *Evolution from Space*, 1981; as well as books by Hoyle himself, *The Intelligent Universe*, 1983, and *The Mathematics of Evolution* (1999).

In the British newspaper *The Independent* (August 23, 2001), Chandra Wickramasinghe opined: "Hoyle had no respect for the boundaries between scientific disciplines, which were artificial social constructs that often stood in the way of a proper comprehension of the cosmos. The Universe does not respect the differences between physics, chemistry and biology, he would say, and his career in astronomy progressively embraced all these disciplines. . . Hoyle taught us by his example to explore the world and search for truth objectively and fearlessly, without prejudice, being guided only by the compelling trajectory of logic. Hoyle often condemned the enormous social pressures that are brought to bear on scientists nowadays to conform. He sneered at the modern practices of peer review and science umpiring conducted by journals, declaring them to be an invitation to unconstructive conformism, an impediment to the progress of science. For expressing such forthright views, he was criticised by the scientific establishment and he made many enemies."

Hoyle was also a great popularizer of science, from whom this editor as a youth took inspiration—in Hoyle's superb treatments of astronomy and cosmology. Hoyle also inspired many with some of his exemplary science fiction, including the memorable *The Black Cloud*, in which an astronomically large plasmatic intelligent organism enters the Solar System. In the UK, Hoyle captivated large radio and television audiences with his lectures on astronomy and science.

During the period 1945 to 1972, Hoyle was at Cambridge University. In 1958 he became Plumian Professor of Astronomy there. He was also director of the Institute of Astronomy. Retired from Cambridge in 1972, he continued his work at a variety of British universities, principally University College, Cardiff.

Hoyle also made major contributions to developing the theory of the structure and evolution of stars and to nucleosynthesis. Many have commented that Hoyle was unfairly left out in the awarding of the Nobel Prize in Physics only to a collaborator.

In the obituary in *The Independent*, Chandra Wickramasinghe recalled, "In 1962 Hoyle and I sought to understand the nature of cosmic dust, those gigantic clouds of obscuring matter that could be seen in photographs of the Milky Way. At the time we began our researches the generally accepted view was that these cosmic dust particles are similar to the micron-sized ice crystals found in the cumulus clouds of the Earth's atmosphere. We challenged this paradigm by showing that carbon particles are a more plausible model for the dust, and over the years astronomers have come to accept this carbon (graphite) grain theory as being close to proven. We ourselves moved on from inorganic carbon dust to organic dust and finally to biological particles for the composition of the interstellar dust. In 1977 Hoyle and I argued that the origin of life on Earth must have involved the importation of viable cells from space, thereby challenging another Holy Grail of science, 'The Primordial Soup Theory,' for the origins of life. At first this theory, known as 'panspermia,' was regarded as heretical, but new evidence from many directions appears be moving towards a vindication of this point of view. Last month the first evidence of microbes at the edge of the Earth's atmosphere at 41km was presented in a paper to a meeting of the Society of Optical Engineering. Hoyle himself was unable to see the final form of this paper although he was a co-author and mentor of this work."

Hoyle's biographical summary from *The Independent*: "Fred Hoyle was born in 1915 in Bingley, and educated at Bingley Grammar School and Emmanuel College, Cambridge, where he studied Mathematics. In 1939 he was elected a Fellow of St John's College, Cambridge, and in 1945, following Admiralty Service during the Second World War, joined the Cambridge University Department of Mathematics as an Assistant Lecturer. Although he paid little attention to accolades, awards and approbations, he received many honours and distinctions. He was awarded the UN Kalinga Prize for the popularisation of science in 1968. In 1997 the Swedish Academy of Sciences awarded him the Crafoord Prize designed to honour work in fields that were not eligible for the Nobel Prize. In 1957 he became a Fellow of the Royal Society, in 1969 a Foreign Associate of the U.S. National Academy of Sciences, and in 1971 the President of the Royal Astronomical Society. He was knighted in 1972. He was an Honorary Fellow at both St John's College and Emmanuel College, and an Honorary Professor at Cardiff University since 1975."

Sir Fred Hoyle is survived by his wife Barbara, whom he married in 1939, and by a son and a daughter.

First Cold Fusion Course

Prof. Hideo Kozima, of the Low Energy Nuclear Laboratory at Portland State University, will be teaching the only known lecture course in cold fusion during the winter term at Portland State University. The course description is as follows:

Winter Term (January to March, 2002); Course Number: PH410/510 (For Senior and Graduate Student) Solid State-Nuclear Physics; Room: SB2-104; Time: 1:00 - 2:50 p.m.

The so-called "cold fusion phenomenon" (CFP) has revealed a wonderful variety of events (from excess heat to transmuted nuclei) simultaneously occurring, mainly in transition-metal hydrides and deuterides, with characteristics difficult to explain using knowledge of current nuclear and solid state physics. This course gives 1) fundamentals of quantum mechanics necessary to understand CFP, 2) essential experimental facts of CFP, 3) phenomenological explanation of CFP by a model with an adjustable parameter, and 4) Solid State-Nuclear Physics, or possible physics of basic processes underlying the successful model.

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speak for all scientists, but in fact it ignores any scientists who may want to go in other directions. In effect it operates to suppress scientific pluralism by denying the existence, if any, of factions. It exemplifies within science a fascistic tendency, the Dictatorship of the Professoriat. . .the symbol of fascism being a bundle of rods bound together (the better to drub the taxpayer).

In its principles of governance, today's science could thus be likened to a fascist province within the larger democratic state. A few details do not fit this model: For the single dictator is substituted the consensus of a loosely-defined junta of like-minded, mutually-admiring Authorities. But the basic principle of ruthless suppression of minority factions, on which the totalitarian state is founded, is rigorously effectuated. To be sure, an appearance of open-mindedness is obligatory even within the most consistently fascistic state: In every age physics has treasured its all-licensed fools, its court jesters who can do no wrong. In my youth it was W.F.G. Swann, later it was J.A. Wheeler, nowadays Ed Witten. . .but these are there as window dressing to hide an intellectual tyranny by the Big-Brained Majority, the conformist constituents of consensus.

In science new ideas always begin small, owing to the fact that they necessarily originate in the single human brain. (Sorry, the Internet will not change this.) If you possess social machinery for the suppression of factions, the logical time to put it into operation is when the factions are at their smallest and most vulnerable. The mechanisms of scientific fascism, such as rote editorial rubber-stamping of unimaginative refereeing, are well-designed to achieve such suppression optimally—*viz.*, before the errant idea has been properly communicated by its originator. Failing that, the next and even more effective weapon of orthodoxy against unwanted new ideas is universal ignoration by the Big-Brained Majority. That simple act of shunning—just letting the thing wither on the vine—is almost infallible. (The Internet will not change this, either.) If shunning fails, a small faction will form. But, the ethos of science being inimical to factions, this is an unstable condition. The faction must either wither or over-night blossom into the new orthodoxy. The latter occurrence is known as "progress," or a paradigm-shift. In such an intellectual climate the measure of competitive survivability of an idea is less its intrinsic merit than its capacity to reinforce the market's fad of the moment.

That is to say, such progress seldom or never happens unless the new idea is some lightly-disguised form of the old ones, embodying a recycling of "accepted" assumptions. (That seems a necessary but not sufficient condition for assimilation of any new idea.) Einstein's special relativity theory, supposedly an altogether new theme in physical description, was acceptable because it was a recycling—even an apotheosis—of Maxwell's equations. Schrödinger's quantum mechanics was acceptable because it looked so much like Hamilton-Jacobi mechanics. (Thus, in general a paradigm shift is not a new genus, but merely a sport of normal science—a difference of degree, not of kind.)

This sort of "progress" through either incremental or discontinuous elaboration of accepted doctrines, though sometimes fantastically fruitful (as in the quantum case), can lead alternatively to the most grotesquely speculative of lost-sheep meanderings—typically arriving at absurdities such as "inflation in the early universe," an imagined condition in which physical laws as we know them are conveniently set aside in a prior epoch in order that they may be preserved in the current one. (Or, rather, in order that we may be preserved from having to rethink them in the current one.) The paradigm shift that reinforces a fad may thus represent simply a mutual resonance of bad ideas.

In principle there is nothing wrong with such progress or with absurd theory. Indeed, a tolerant attitude is to be recommended toward the absurdities of any faction. . .since the success of quantum mechanics warns us that Nature is more absurd than anything we may readily imagine. The significant word here is "faction." It is fine for any faction to be as absurd as it likes. . .but it is fatal to any permanently valid form of progress for any single faction to gain the undisputed upper hand and to warp by its private absurdities the subsequent growth of all human science. Are the shoulders we stand on today really those of giants? The more warped a science is, the more warped it must become, since alternatives (factions) killed are fiducial standards (checkpoints) lost forever. The unasked twelfth question the NRC should be raising is: *Why must we all think alike?*

The NRC's faction-killing intellectual totalitarianism is illustrative of what is fostered worldwide by current systems of higher education. Too often we find the Professors to be the intellectual heirs of Cotton Mather—so dedicated to truth, ever aiming so high, that tolerance of Satan's work, of error, of factionalism, has been driven from the temple. Under such a regime, bomb-proof conformity is what offers to the prudent man maximum survival probability. To the conformist mind anything not conforming to foreknown truth is anathema. (How else to explain the physicists' reception—at their 1989 APS meeting—of "cold fusion" claims? The like of it has not been seen since Christian monks tore to pieces the pagan philosopher Hypatia at Alexandria in 415 AD.) The Professors at every moment must have something to teach, which means something to know, which means there is no moment at which they can be patient and coexist with *not knowing*. In other words, they are the worst people in the world to send to the frontier to *seek* knowledge, because they are its custodians. What fool seeks what he already has?

In sum, academic science, which promotes itself as the only science, is an essentially fascistic system dedicated at

Like normal scientists in all times, those of the NRC behave as if their uniquely-privileged generation were teetering on the brink of final truth. Just a little more effort, a last push in exactly the direction they are already headed, a final eruption of Nobel prizes, and voilà.

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distinguish knowledge in science from knowledge in other spheres of human interest, such as religion and politics. He writes, "But little if any scientific knowledge is *purely* objective, *purely* 'how to,' *purely* map-like. Its map-knowledge is usually closely tied up with theories, which are story-knowledge. And just as knowledge can hardly be *purely* map-like, so to, little if any knowledge can be *purely* story-like. Stories are usually set in some environment that stimulates, to some degree, the real world around us, and to that extent the story-knowledge may be empirical, map-like." (*Fatal Attraction*)

Certainly not a young-earth creationist, Bauer does, however, insist on this difficult point in map vs. story knowledge, and I agree with him: "Everyone seems to have trouble realizing that the theory of evolution is not a fact. That is true of laypeople as well as scientists. . .Anyone who says, 'evolution is a scientific fact,' ought at once to be challenged to explain in more detail: Does that included the origin of living things from inanimate matter on Earth? Do you insist that the mechanism of evolution was *solely* natural selection among chance variation? Simply posing those questions, and then asking for evidence to support the answers, ought to give some small pause to even the most dogmatic scientist." (*Fatal Attraction*)

A biographical curiosity of the author is that he holds a Ph.D. in electrochemistry and was even on sabbatical (1972-73) at the University of Southampton where Martin Fleischmann was a professor, but Bauer did not later become deeply immersed in the cold fusion controversy. Bauer had worked in electrochemistry for twenty-five years. He was born in Austria in 1931, was educated in Australia, and became an American in 1966. In the early 1970s he happened upon the Loch Ness monster controversy. He gradually became convinced (and remains convinced) that the preponderance of the evidence supports the finding that "Nessies" really do exist. That is how Bauer became involved in anomalistics in the first place. Because of his growing interest in the dynamics of scientific controversies, he switched his academic field to the area of social science widely called Science and Technology Studies ("STS"). He has shown great understanding for the many quests for acceptance by various anomalist and heretic communities. He has been charitable to the cold fusion camp too, although he disappoints us (myself and my colleague Jed Rothwell) by apparently not having explored in sufficient detail the published cold fusion evidence to be convinced beyond reasonable doubt that cold fusion is real.

Of course I am very pleased that he does write in *Science and Pseudoscience*, "The best written book about the [cold fusion] matter (Bauer 1992c; Mallove 1991) has only the drawback of the unwavering belief that cold fusion is real." Bauer also wrote for *JSE* a generous review of our 1999 video documentary "Cold Fusion: Fire from Water," and in a companion review was impressed with Charles Beaudette's *Excess Heat* (2000). However, the dust jacket of *Science and Pseudoscience* states, "A scientist himself, Bauer points out that some phenomenon that have turned out to be spurious, such as polywater and cold fusion, were for a time taken quite seriously by respected members of the scientific community." Concerning this notation, Henry wrote me apologetically last July, and explained that this text came from a slip-up in communication with the publisher. He stated that, "Anyone who reads the text of the book, of course, will see that's not the case." Honestly, I'd have to split hairs to agree with that.

Bauer introduces the basic cold fusion history fairly and he properly takes some of the egregious critics to task, but this is followed by several assessments with which I cannot agree. He writes, "More than ten years after the announcement, it seems increasingly unlikely that there is any genuine energy-yielding process in 'cold fusion.'" That is softened just a bit with the remark, "Still, it is not clear that cold fusion is wrong or impossible." He also finds merit with the notorious error-laden, dismissive book, *A Dialog on Chemically Induced Nuclear Effects: A Guide for the Perplexed about Cold Fusion*, which a review in this magazine by Jed Rothwell has soundly torn apart (see *IE* No. 3). Bauer unfortunately lends some credence to opponents' criticism of Fleischmann and Pons' initial reporting of their neutron emission data (". . .their attempts to change or fudge those data is reprehensible"). In fact, the record shows that no such "fudging" occurred. Moreover, the most egregious "fudging" in the entire cold fusion affair was the outright fraud in calorimetric data manipulation in the negative direction, perpetrated by the influential MIT Plasma Fusion Center. This matter and related academic misbehavior, to which *Infinite Energy* and others have devoted much attention over the years, formed a key turning point in the cold fusion saga; unfortunately Bauer did not mention this at all.

Bauer also apparently does not recognize the plethora of evidence (helium, transmutations, gamma signatures, tritium, fogged x-ray film, etc.) that persist after a particular successful cold fusion experiment. Otherwise he might not have written, "One cannot afterward reexamine exactly what was done to look for clues as to why it was successful or unsuccessful." Other matters in the cold fusion treatment could be criticized, but I'll conclude by expressing hope that Prof. Bauer will undertake a significant revision of the section for a future edition, after a more thorough study of the cold fusion literature.

Another topic that Bauer has gotten significantly wrong—much more wrong than his cold fusion treatment in my view—is his assessment of Wilhelm Reich. To be fair, if I had not been informed of the quagmire of prevailing grossly inappropriate Reich criticism, through the exemplary experimental work of Dr. Paulo and Alexandra Correa (www.aetherometry.com), I would not have been able to judge Reich's work fairly and might have given a free pass to this aspect of both Bauer books. Bauer writes of Reich's "doubtful status as a scientist." With misplaced approval he cites CSICOPer Martin Gardner's critique: "Unless one understands something of the scientific issues or has come across critiques like Gardner's (1957, Ch. 21), there are few clues that orgonomy is spurious rather than genuine science." Through Gardner's misinformation, he completely misrepresents Reich's 1941 encounter with Einstein and Einstein's demonstrably unscientific response (see *IE* No. 37). Bauer concludes, "Such as they are, Reich's connections to the mainstream have best survived the passage of time in psychotherapy and perhaps sociopolitical matters, not in biological or physical sciences." In my view, this assessment will not stand and, in fact, will become an embarrassment.

In conclusion, much as I applaud the overall scholarship

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ited resources of the only designated basic-science funding agency, the NSF) two other moneyed agencies, DOE and NASA—two more rods to bind into the bundle. We have to ask, is it really a good idea to get the various agencies pulling together, all on the same team? It is certainly tempting to think so. On a one-shot basis, for a worthy objective—teamwork being such a great American invention—what could be wrong with it? Well, several things. For one, there is the "worthy objective" issue. If it were all that worthy, all that beneficial to the taxpayer, would it be so hard to convince Congress? Why not the one-shot increase of NSF's budget to achieve this inspiring, heaven-storming connection of quarks to the cosmos? Maybe because Congress has too much horse sense? A type of sense in which the individual agencies are hopefully more deficient individually, and still more deficient collectively? (Oh, what a tangled web we National Researchers weave. . .)

Then there is the "teamwork" issue, a matter of general principle: Is it a good idea or a bad idea to get the agencies pulling together? It sounds good, but maybe on the whole it lies on the bad side. At what point does the binding-together principle of teamwork edge over into that of fascism? The agencies are already great amalgamations (hence suppressions) of competitive interests. NSF represents the whole contending spectrum of every sort of basic research in the U.S. I have hinted here that the studied preservation of pluralism in our society is a must, if democracy is to resist the ageless seductions of fascism (the running of the trains on time, etc.). Any proposal to amalgamate already highly-amalgamated agencies, even on a one-shot basis, will work toward placing control of the taxpayer's dollar in fewer hands. Let me say it again: If the issue really is important to human knowledge, and if knowledge is that important to the taxpayer who must pay for it, let the case be made to Congress, which under our system of government is there mainly for the purpose of allocating resources.

Having thus dealt destructively with the NRC's proposed way to use tax money, let me conclude with certain more constructive thoughts on what is needed to nudge basic physics (and perhaps other hard sciences as well) back on-track. It is my opinion, and the presumption underlying the preceding discussion, that any objective observer can glance at today's physics and perceive something about it to be rotten. Indeed, its rigorous logic more or less guarantees its rigorous rottenness. Students can perceive this better than their more firmly-committed elders. (That might explain the observed high drop-out rate of the cream of the physics-student crop.) Like a genetically-improved apple, a science rots from the inside out. That is, the fault lies in the fundamentals. Somewhere at the very heart of the matter, far from the madding frontier's ignoble strife, lies a false assumption, one or many. And what is being done about it? Are the fundamentals being researched with meticulous care, probed with skepticism, urgently tested and re-tested by the best minds of the profession? Not on your tintype. When was the last time a student's question was allowed to interrupt the flow of a Professor's exposition of known truth? Let me rephrase that: When was the last time a Professor dropped his government-funded research long enough to enter a classroom in which the fundamentals were being taught? When was the last time a Professor of Physics confused his brain or blotted his grant application with a spontaneous or irreverent question about any of the deep-buried foundations of his subject? Echo answers.

My proposed solution is addressed as a plea to the funding agencies: Oh, Bureaucrats, set aside as sacred and protect from academic rapacity with your lives, if need be, a minuscule fixed fraction—say, 0.1%—of your research budget, to be devoted solely to *questioning the fundamentals*. I mean honest questioning, based on recognizing the possibility of alternative candidate theories and motivated by genuine skepticism about the "truth" of the assumptions on which the academicians build their multi-tiered cloud castles. Since no such skepticism exists within academia (except covertly, for there it is the essence of political incorrectness to harbor doubts about the "party line"), I assume that would mean earmarking most of this segregated funding for non-academic, non-card-carrying scientists. (But, of course, where the academic oyster can be probed and a genuine skeptic found, there indeed is a pearl beyond price.) Since such deliberate creation of factions within a science and encouragement of aberrant presuppositions is "against nature" (*i.e.*, against the fascistic tendencies of self-aggrandizing Authorities), such proto-pluralism has to be protected by the funding agency in much the same way a bed of young carrots has to be protected from the depredations of hungry rabbits.

Against this proposal is the fact that it is not easily implemented. It takes guts to play the role of Farmer McGregor (the bad guy) against a righteous army of fanged rodents. . . and regrettably few bureaucrats have guts. The federal bureaucracy (Civil Service) happens to be another profession in which consensus rules and conformity pays.

Favoring my proposal is the fact that experiments probing past assumptions (*e.g.*, nineteenth-century foundational physics) are comparatively cheap in today's terms, and alternative theory development is dirt cheap, so even the small amount of money we are talking about should go a long way. Like a shower of rain in the desert, it might produce a surprising efflorescence: 1) It would directly counter the current viciously fascistic trend to kill off all theories except a consensus-endorsed "standard" one. 2) Through encouraging pluralism of physical theorizing, it should help to correct tunnel vision. 3) It should culturally enrich science and enhance public appreciation of the multi-sidedness of physical description. 4) It should provide "theory calibration" *standards of comparison* by which party-line theories might objectively justify their acceptance. . .so that scientific Authorities could be kept honest in a way independently verifiable by non-specialists. 5) Through enhanced randomization of spins, it should help in a general way to reduce the influence of media spin control on science funding allocation. I do not assert that a dollar spent this way would bring the taxpayer more benefit than $1000 spent the NRC's way. . .but I think it. ■■■

About the Author
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Comments on National Research Council Aims, Methods, and Assumptions

Thomas E. Phipps, Jr.*

Editor's Note: In the following commentary, the incomparably incisive and witty Dr. Phipps holds forth against a particularly nasty bit of Fizzix "consensus-building." His sharp pen contrasts Academe's obsession with cultural and other diversities with its rigorous exclusion of "foreign" theories. Monotheorism (you heard it first here!), indeed, is the greatest obstacle to progress in physics. Phipps can be constructive too. He makes a rational proposal: "Oh, bureaucrats, set aside as sacred and protect from academic rapacity with your lives, if need be, a miniscule fraction—say 0.1%—of your research budget, to be devoted solely to questioning the fundamentals." That's simply too reasonable and generous to be expected from academic physics. It will never happen.—EFM

The following comments refer to the forthcoming 2001 report by the National Research Council (NRC) entitled, "Connecting Quarks with the Cosmos: Eleven Science Questions for the New Century." [View the report on the World Wide Web at http://books.nap/edu/books/0309074061/html/index.html.] Its intention is to get three major U.S. government agencies (Department of Energy, National Science Foundation, NASA) to pool their resources and orient priorities in support of "frontier" research on the *cutting edge*, as favored by an influential group of academic scientists, primarily physicists, and astronomers.

Since the study will be completely one-sided—as would be expected of any cream-allocation assessment prepared by a pride of the larger cats—it will not be amiss to register counter-opinions of possible interest to the taxpayers whom the agencies in question are chartered to serve.

On campus these days, "diversity" is the good word. . .but never in departments of science. There, the good word is "consensus." Consensus of opinion, the exact opposite of diversity, is supposed to be the key to an effective truth-search strategy. Truth in science, as in the military case, is to be determined by a body count. In the whole history of science it has never worked that way. But history of science is not something to which today's working or politicking scientist feels obliged to genuflect.

Prudence recommends in all fields of human endeavor a self-protective strategy: the deliberate maintenance of diversity, pluralism, factionalism, etc. Democracy, for instance—a system of checks and balances—is a prudential form of government. What has this to do with science? Simply that the principles of governance do not differ all that much from one area of human activity to another. A prudential strategy should recommend itself even to the know-it-alls of science. In today's basic science, alas, prudence has been discarded. Physicists, for instance, are betting all their assets on the so-called "standard" theory (which cannot explicitly describe nuclear "forces" nor furnish a nuclear dynamics), as if it were the only horse capable of winning the race. Yet that horse is one of many bred in the stable of Claudius Ptolemy (*i.e.*, it follows in the tradition of employing arbitrary adjustable constants as needed). Such a betting policy embodies the opposite of prudence. It adheres strictly to Mussolini's advice, "Live dangerously."

In the matter of aims, we find the NRC reflexively aiming high. This, too, is dangerous—being one of many ways to miss the target. Like normal scientists in all times, those of the NRC behave as if their uniquely-privileged generation were teetering on the brink of final truth. Just a little more effort, a last push in exactly the direction they are already headed, a final eruption of Nobel prizes, and *voilà*. Ah, but that last push requires money. . .and to get it they do not scruple to put a bit of political pressure, via their report, on recalcitrant government agencies. Their method is to use the theory-consensus of a few scientific Authorities to define the Important Future Problems. This consensus is supposed to

> *In its principles of governance, today's science could thus be likened to a fascist province within the larger democratic state. A few details do not fit this model: For the single dictator is substituted the consensus of a loosely-defined junta of like-minded, mutually-admiring Authorities. But the basic principle of ruthless suppression of minority factions, on which the totalitarian state is founded, is rigorously effectuated . . . an intellectual tyranny by the Big-Brained Majority, the conformist constituents of consensus.*

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3. Standard Relativistic Approach

1. The light has the same velocity (c) in every direction and for everyone, so also for the two stations, no matter where they are placed.

2. The time which the signal takes will be the same in the two cases of Figure 1.

3. The movement of the two stations due to rotation, no matter what effect it might have on the clocks, will be the same for both of them, since there are no privileged directions and the relative motions are symmetric.

4. This means that no time difference will be detected by the two clocks.

4. Review of the Inertial Transformations

F. Selleri[3] rephrased SR, *without the conventional assumption.* So he got new transformations, more general than those of Lorentz.

Assuming:

(i) Linearity of the transformations among inertial systems in relative motion;
(ii) Homogeneity of space and time;
(iii) Existence of an isotropic inertial system S_0 (ether) in which the one-way speed of light is c in every direction;
(iv) Invariance of the speed of light on closed paths in every inertial system;
(v) Time dilation of all the clocks in motion with respect to S_0 by the factor:

$$\gamma = \frac{1}{\sqrt{1-\beta^2}} \qquad \text{where} \qquad \beta = v/c$$

and v is the clock velocity measured in S_0, one obtains the following General Transformations between any system S, in "absolute" motion with velocity v (in the direction of $+x$) and S_0:

$$\begin{cases} x = \gamma(x_0 - vt_0) \\ t = \dfrac{t_0}{\gamma} + e_1(x_0 - vt_0) \end{cases} \tag{1}$$

e_1 is a parameter that remains free. The General Transformations (1) explain all experimental evidences *independently* of the chosen value of e_1.[3,8]

If we presume that light propagates isotropically in one-way mode in every inertial system, we will adopt Einstein's synchronization where e_1 will be set as $e_1 = -\frac{\beta\gamma}{c}$. In this case (and only in this one), the principle of relativity is valid in its strong form and the (1) become the Lorentz transformations.

There are good reasons[3] to set $e_1 = 0$ and so (1) becomes the Inertial Transformations:

$$\begin{cases} x = \gamma(x_0 - vt_0) \\ t = \dfrac{t_0}{\gamma} \end{cases} \tag{2}$$

This choice, without contrasting with any experimental data, gives a different vision of the world, pretty much different from the relativistic one:

1. An absolute space (ether) and an absolute time exist, those of S_0.

2. The rods in absolute motion, at v velocity, contract by a factor $1/\gamma$ and the clocks in absolute motion decrease their pace by the same factor $1/\gamma$, as in SR.

3. But, differently from SR, these effects are not "of perspective," they are real and absolute: the system in absolute motion measures the *extension* of the rods and the *increase* of the clock pace of the (S_0) system in absolute rest. These variations are of the same extent as the contractions measured by S_0. To prove that, it is sufficient to invert the (2).

4. In fact, the (2) between two S_1 and S_2 systems, both in absolute motion (with v_1 and v_2 velocity) become:

$$\begin{cases} x_2 = \dfrac{\gamma_2}{\gamma_1} x_1 + \gamma_1\gamma_2(v_1 - v_2)t_1 \\ t_2 = \dfrac{\gamma_1}{\gamma_2} t_1 \end{cases} \qquad \begin{cases} x_1 = \dfrac{\gamma_1}{\gamma_2} x_2 + \gamma_1\gamma_2(v_2 - v_1)t_2 \\ t_1 = \dfrac{\gamma_2}{\gamma_1} t_2 \end{cases} \tag{3}$$

$$\text{where} \qquad \gamma_1 = \frac{1}{\sqrt{1 - v_1^2/c^2}} \quad ; \quad \gamma_2 = \frac{1}{\sqrt{1 - v_2^2/c^2}} \tag{4}$$

From (3) we obtain that lengths and durations transform by multiplying them by the ratio between the two system contraction factors.

5. The absolute velocities are composed in a Galilean mode, but the measurements of velocity in absolute motion systems are made false because of the contraction of rods in the motion direction ($1/\gamma$) and of the slowing down of clocks ($1/\gamma$). Therefore, velocities which are parallel to the absolute v of the moving system S will be measured, in S itself, as increased by a factor γ^2 (contracted rods and dilated time), the ones which are perpendicular to v, will be increased by a factor γ (only dilated time).

A velocity, in S, in an arbitrary direction, can be decomposed into three orthogonal components (Figure 2); we transform it to S_0 (absolute velocities) by dividing the v parallel component by γ^2 and the perpendicular ones by γ; we sum it (in a Galilean mode) to the v of the S system and we compose it again using Pythagoras.

If a body p moves at a u_p velocity, with respect to the S system in absolute motion at v velocity, its absolute velocity v_p will

$$v_p = \sqrt{\left(v + \frac{u_p \cos\vartheta}{\gamma^2}\right)^2 + \left(\frac{u_p sen\vartheta}{\gamma}\right)^2} \quad \text{(where } \vartheta \text{ is the angle between up and } v\text{)} \tag{5}$$

6. As a consequence of (5), the velocity of light *is isotropic in S_0 only*: for the system S in absolute motion, replacing u_p and v_p by $c_{(\vartheta)}$ and c respectively, one gets

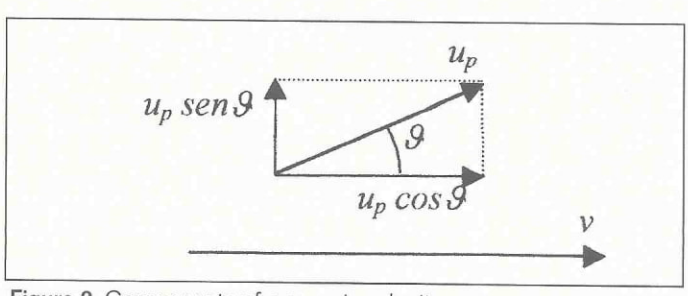

Figure 2. Components of a generic velocity.

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any epoch to suppression (through consensus) of all factions but one. It arrives at this undesirable condition, wholly inimical to the discovery of real truth in either the long or short term, through aiming too high; that is, through demanding *truth now*—or, if not now, as quickly as possible. For prudence it has substituted impatience as its governing principle. Knowledge of truth excludes the search for truth. Thus by the very terms of reference of academia the institutionalization of higher learning works none-too-subtly against the possibility of higher learning. Consensus makes of conformists absolute monarchs. Where it rules, the slowest possible rate of genuine scientific progress is to be anticipated, and the highest noise level of hype.

What, then (if we discredit consensus), is to keep a science on-track—assuming there is a track? Under a pluralistic system, factions contend, all things are tried, and the good are in general preferentially held fast, so there should be a comparatively rapid drift of the science as a whole in the right direction. The process, though unhappily fractious, is healthy. But when over a long period of time a single faction dominates, to the exclusion of all other lines of thought, all things are *not* tried nor even conceived nor tolerated as thinkable. The process, though happily self-confirming, is pathological. There is a drift in some direction, but surely close to zero probability of its being the right one. Thus today's conformists who claim the ability to detect pathological science invite clinical study of their own pathology. As for current science, we must conclude that there is *nothing* to keep it on-track, and the single example of a reduction to absurdity, cosmic "inflation," is a measure of the extent of drift off-track that has taken place already.

As another calibration checkpoint, consider quantum measurement theory. This is truly the pits. Here, things are so bad that in preference to making the slightest correction to their patently deficient equations—or otherwise attacking their problem in a more fundamental way than mere exegesis or "interpretation"—the Authorities have solemnly weighed such alternatives as the Many Universes hypothesis. According to this, whenever an observable (localized) event occurs, the universe splits into an assemblage of parallel universes, in each of which the same equations prevail with the same old deficiency (inability to describe localized events), so further splitting of each of the splinters is mandatory. In not one of this infinitude of universes are the physicists smart enough to consider improving their equations. If cosmic inflation denies the laws of physics in order to preserve them intact, Many Universes denies the uniqueness of the experience physics is chartered to describe by laws. Is greater absurdity possible? If so, trust theoretical physicists to find it.

You must admit, such dedication to the ineradicable Word of immaculate Theory is rather touching. Indeed, scientific faith in equation dogma evokes the same empathy as does Christian faith in the dogma of Virgin Birth (which must, however, be up-dated to accommodate the Virgin's infinite splittings?). But, faithwise, quantum theory is the rock-solid essence of conservatism compared to string theory and its ilk. There, we see *beauty* prancing bare and running amuck amid curly dimensions, without even the traditional fig-leaf of experimental support. Considering that fadism is to physics what crisis management is to Democracy, you might judge string theory to be the ultimate fad. . .except that in fadism physicists seem determined to prove there is no "ultimate."

So much for the quality of the presuppositions on which the NRC's eleven questions are based. The processes of generalization and abstraction, dear to the hearts of mathematicians, have been at work in physics unchecked for the last forty years, to the point where only token contact with observation remains discernible. Among theoretical physicists and probably astronomers (and, shudder, perhaps even engineers) there has been an accompanying cultural shift reflecting a quiet seizure of power by what one could call mathematicians, though pilpul artists might be a better term. This explains the fact that no pain is felt concerning the communal drift away from reality. As a lifelong witness of this trend in physics—which I consider degenerative, physics being otherwise the noblest of sciences and mathematics being only what I would term the most challenging of mental games—I venture to offer this advice to the three government agencies targeted by the NRC:

Ignore the eleven questions, which are mostly medicine-man's drum-beating, and scrutinize most carefully the proposed experiments, which are what you are being asked to buy. Discard out of hand any that are capable only of *confirming* the Authorities' pet theories. Give serious consideration to funding at some reasonable level only those experiments capable of decisively *falsifying* one or more of those theories. The reason for avoiding confirmation-type experiments is that the corresponding theories will be taught whether confirmed or not—are in fact already being taught—so that regardless of the outcome nothing will change in the classroom and no real "progress" will occur on the level of basic understanding of Nature. (Only the zeal of the teaching and the hyping-frenzy of *The New York Times* will be affected.) Whereas with falsification-type experiments changes of thinking *could* be forced and that would constitute identifiable progress, albeit of a negative sort. Nature is at least given the option to command, "Halt! About face!" Frontier physics has fallen upon such evil days that only negative signals can have much beneficial effect on it. My guess is that very few of the NRC's proposed experiments will pass this filter. . .and that might solve the funding problem right there. As for the cultural problem—the morphing of the theoretical physicist into the *mathematician manqué*—I have no solution. It may go on until it has killed science and maimed mathematics.

Concerning the NRC's methods, what we have here, what the game is that dare not speak its name, is another in the endless series of attempted end-runs around Congress. Specifically, the NRC seeks to bring in (to augment the lim-

The unasked twelfth question the NRC should be raising is: Why must we all think alike?

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The quantity of matter traversing an arbitrary section (for instance the v perpendicular axis of Figure 3, which passes through the center) in the unit of time has to be constant. In the opposite case, the rotation would have a translation component, which would shift and accumulate (either backward or forward) some matter in time, thus violating the conservation of the quantity of motion of the Earth in S (which, by definition, must be zero).

This condition is also necessary because an observer on S, who counts the number of atoms (or the number of the unitary rods, placed longitudinally on the Earth circumference) which he sees passing in the unit of time, finds the same value in each point: *when the atoms (rods) are more contracted, they go slower.*

It is important to notice that, while the measurement of the rotation velocity u depends on the used transformations, the isotropy of the flow of atoms (or rods) around the circumference is *objective* and cannot depend on the used transformations, hence the result must be the same which would be obtained by a "relativistic" observer who, of course, measures an isotropic flow.

6. The Time Differences

Let us apply, at last, the Inertial Transformations (3) in S and calculate the times taken by the two synchronization signals to travel the distance d as ratios between distances between the two stations and the velocities of light.

$$t_{c1} = \frac{\gamma}{\gamma_1}\frac{d}{c_1 - u_1} \quad ; \quad t_{c2} = \frac{\gamma}{\gamma_2}\frac{d}{c_2 - u_2}. \tag{14}$$

These times will be registered by the stations on the Earth, the former slowed down by γ/γ_1 and the latter by γ/γ_2. Their difference will be (clocks desynchronization):

$$\Delta t'_c = \frac{\gamma}{\gamma_1}t_{c1} - \frac{\gamma}{\gamma_2}t_{c2} = \frac{\gamma^2}{\gamma_1^2}\frac{d}{c_1 - u_1} - \frac{\gamma^2}{\gamma_2^2}\frac{d}{c_2 - u_2}, \tag{15}$$

station A and the second synchronization signal being *in advance* by such a value.

But there is a *second phenomenon* which also produces a desynchronization, and to quantify that we will place ourselves again in S.

The paths followed by the stations, due to the rotation of Earth, are not the same: the symmetry is broken by the presence of a privileged direction, that of the absolute v of translation with which the rotation velocity composes. The different paths followed by the stations produce different slowing downs on their own clocks, the absolute velocities being different. This point is crucial (Figure 4).

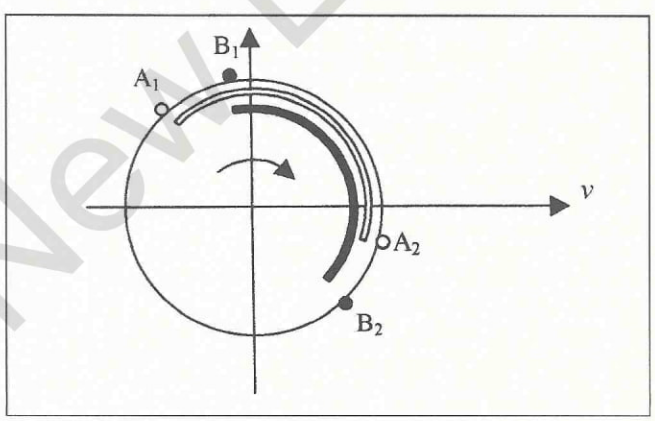

Figure 4. The absolute paths of the two stations are different.

The segment B_1-A_2 is common to the two paths and does not introduce any difference.

The segment A_1-B_1 is traveled only by the station A at a faster (absolute) velocity, compared to the segment A_2-B_2 which is traveled only by the station B at a lower (absolute) velocity. The times marked by the two clocks, in these two segments, will be different: the station A, going faster, will show *a delay*.

The observer in S calculates the times taken to cover the two segments, still as ratios between distances and velocities:

$$t_{u1} = \frac{\gamma}{\gamma_1}\frac{d}{u_1} \quad ; \quad t_{u2} = \frac{\gamma}{\gamma_2}\frac{d}{u_2} \tag{16}$$

As we did earlier, we calculate the difference between these times, but now being considered in the terrestrial stations:

$$\Delta t'_u = \frac{\gamma}{\gamma_1}t_{u1} - \frac{\gamma}{\gamma_2}t_{u2} = \frac{\gamma^2}{\gamma_1^2}\frac{d}{u_1} - \frac{\gamma^2}{\gamma_2^2}\frac{d}{u_2} \tag{17}$$

Not only the distance among atoms (length of rods), but also the pace of clocks in a system that rotates and translates relative to the ether, is submitted to cyclic variations due to the composition of the rotation and translation movements.

We now show that the two time delays cancel, so that:

$$\Delta t'_c + \Delta t'_u = 0 \tag{18}$$

From the definitions (15) and (17) one easily gets

$$\Delta t'_c + \Delta t'_u = \frac{d\gamma^2}{\gamma_1^2}\left[\frac{1}{c_1 - u_1} + \frac{1}{u_1}\right] - \frac{d\gamma^2}{\gamma_2^2}\left[\frac{1}{c_2 - u_2} + \frac{1}{u_2}\right] \tag{19}$$

which is the same as

$$\Delta t'_c + \Delta t'_u = \frac{d\gamma^2}{\gamma_1^2 u_1^2}\left[\frac{u_1^2}{c_1 - u_1} + u_1\right] - \frac{d\gamma^2}{\gamma_2^2 u_2^2}\left[\frac{u_2^2}{c_2 - u_2} + u_2\right] \tag{20}$$

The first (second) term in parentheses in (20) is equal to the inverse left hand side (right hand side) of Equation (8). Therefore these two terms are equal.

Also the multiplying factors are equal because of Equation (13). Thus the right hand side of (20), being the difference of two equal terms, vanishes and Equation (18) holds.

The different times taken by the two synchronization signals are compensated by the variations of the rates of the two clocks, which are in a variable absolute motion composed of the constant translation velocity v, plus the rotation velocity u (variable in direction and modulus).

Therefore the two stations will not, in any case, detect any out-of-phase condition between the clocks because the two effects compensate each other exactly in any position and in any angle with respect to v.

Note: To reach a correct synchronization of clocks in a rotating system in accordance with SR, in general the Sagnac

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What Does the International Atomic Time System Say About the ONE-WAY SPEED of LIGHT

Romano Manaresi*

— Abstract —

Some physicists bring forward the proper functioning of the International Atomic Time system (TAI) in order to support the postulate of Special Relativity Theory about the isotropy of *c* one-way which has never been demonstrated. The atomic clocks of the TAI stations spread all over the world are perfectly synchronized at every time of the day by radio signals traveling in every direction on the moving Earth. In opposition to what it may seem at first sight, it will be demonstrated that the proper functioning of the TAI system does not imply the isotropy of *c* one-way on the moving Earth. Therefore the second postulate of Special Relativity still remains merely conventional.

1. Introduction

The second assumption of Special Relativity Theory (SR) has never been verified (nor denied), that is: the speed of light is the same, in all inertial systems, in every direction.

In fact, what has been proved is that the speed of light (*c*) is the same in all inertial systems, on closed paths. This only means that *c* is the average speed between that of going and that of return.

The famous Michelson-Morley experiment and all the main methods of measurement of the speed of light are either equivalent to measures on closed paths or are in any case insensitive to the one-way speed of light.[1-3]

As we know, to measure *c* one-way we need two synchronized clocks in two different places. But to synchronize them according to SR we must use an electromagnetic signal which is presumed already travelling at *c* speed.

Therefore this type of experiment does not prove anything about *c* one-way.[2] Poincaré believed this speed unknowable forever (Poincaré's curse)[4] and Einstein himself admitted the *conventional* character of the assumption in question.[5]

2. International Atomic Time System

Today a network of atomic clocks exists all over the world and they are continuously connected by radio signals of synchronization; they supply the International Atomic Time (TAI, Temps Atomique International).

It is verified that the synchronization signals sent by a transmitting station always arrive at the receiving station "on time" (that is, always with the same traveling delay) at any time of day and in any season, despite the motion of Earth.

Some people[6-7] say this means that these signals propagate isotropically (with one-way velocity *c*), even on the moving Earth.

They consider two stations with atomic clocks, separated by a distance *d* (measured on the Earth). The first one transmits synchronization signals at regular time intervals to the other one. Twelve hours after the first synchronization, due to the Earth's rotation, the radio signal goes to the opposite direction of the previous one, and if its velocity were not constant, a phase-difference between the clocks would be detected. This does not happen. On the contrary, the signals always seem to arrive with the same traveling delay *as if* the velocity of light were also isotropic on Earth, which moves into the ether at least at its orbital velocity $v \cong 30$ Km/sec. In fact, in the Galilean approach, even considering only this minimum velocity, we would measure one $\Delta t \approx 10^{-6}$ s between the clocks (whereas the minimum accuracy of used clocks is of 10^{-7} s).[6-7]

In what follows I will show that *not even* the proper working of the TAI imposes the isotropy of the one-way speed of light in all inertial systems and such assumption still remains therefore conventional.

To demonstrate that I will use Selleri's Theory and his Inertial Transformations.[3] In such a theory the concepts of absolute space and time are retained and, consequently, the one-way velocity of light *does not* have the same value in all inertial systems.

The situation, in two generic moments of synchronization, might be the same as shown in Figure 1 (we neglect the Earth curvature in the path of length *d*). The synchronization of the atomic clocks, experimentally detected, is an objective fact and must be predicted by observers at rest in every reference system. We will name S the inertial system, which moves at velocity *v* in accordance to the Earth but, of course, does not rotate.

In this system we are going to consider this situation, at first by using SR and the Lorentz Transformations, then by Selleri's Inertial Transformations.[3]

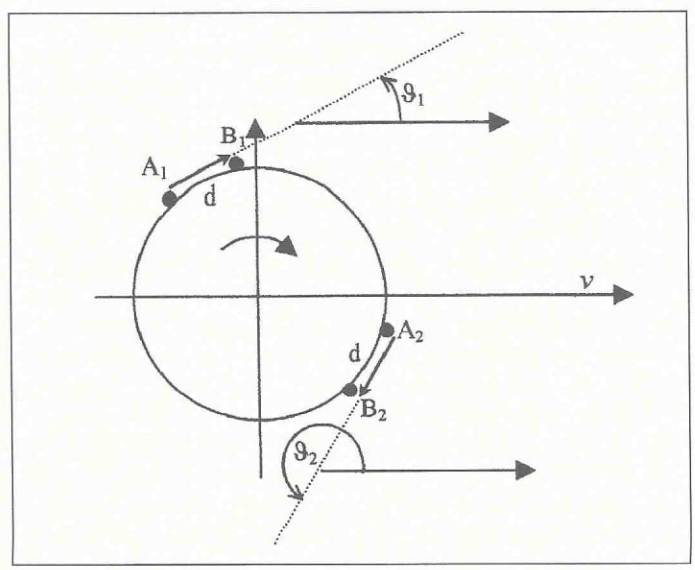

Figure 1. Generic situation during two subsequent moments of synchronization between the stations.

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Neutron Evolution from a Palladium Electrode by Alternate Absorption Treatment of Deuterium and Hydrogen

Tadahiko Mizuno,* Tadashi Akimoto,** Tadayoshi Ohmori,†
Akito Takahashi,†† Hiroshi Yamada,‡ and Hiroo Numata‡‡

[**Editor's Note:** *This is an abbreviated version of a longer paper which was submitted to the Japanese Journal of Applied Physics. The article appeared in Jpn. J. Appl. Phys., Vol. 40 (2001), pp. L989-L991, Part 2, No. 9A/B, September 15, 2001.—EFM*]

— Abstract —

We observed neutron emissions from palladium after it absorbed deuterium from heavy water followed by absorption of hydrogen from light water. The neutron count, duration of the release, and the time of the release after electrolysis was initiated and all fluctuated considerably. Neutron emissions were observed in five test cases out of ten. Compared to experiments in which only deuterium was absorbed, repeatability was good and the neutron count was high.

In 1989, Fleischmann and Pons[1] reported that palladium electrolyzed in heavy water produces the so-called cold fusion reaction. However, reproducibility and control of the phenomenon have been difficult, and although many researchers attempted to replicate, most failed. After initial interest in the phenomenon faded, the field was largely abandoned, except by a small group of researchers. One reason is that the cold fusion reaction was thought to be conventional d-d fusion. The authors have examined many of the reports of neutrons and heat made to date, and have reached the following conclusions.

First, neutrons and excess heat are rarely observed, but when they are observed, they occur suddenly after electrolysis has continued for a long time. Second, many instances have been reported in which these effects occurred when the cell was replenished with new electrolyte. Third, it is known that when electrolysis is used to absorb deuterium into palladium, at first the electrolyte contains almost pure heavy water, but later the electrolyte becomes mixed with light water.[2] This substitution occurs because heavy water is hydrophilic, and light water permeates even a nominally closed cell at some stage during the process, gradually diluting the heavy water.

Based on these considerations, we conclude that the cold fusion reaction must be something quite different from conventional d-d fusion. Furthermore, the reaction must involve factors other than absorption of deuterium. Especially after electrolysis has continued for a long time and the heavy water has been replenished, light water is very likely to be mixed in with it. Also, after electrolysis loading has reached a certain point, any hydrogen present in the cell will block the absorption of additional heavy hydrogen into the cathode. Also, in view of these considerations, we predict that certain triggers are needed for the reaction to occur.

In our experiment, we used a cathode made from Tanaka Precious Metals Corp. palladium wire, 99.9% pure, 1 mm in diameter, cut into 3 cm segments. The lead wire was made of tungsten, 1.5 mm thick, 150 mm long. The electrolyte was composed of 100% pure heavy water from Acros Organics, and K_2CO_3 reagent from Kanto Kagaku Corp., which was 99.5% pure, and was adjusted to 0.2 M concentration. The reagent was heated to 300°C in an electric furnace to evaporate all of the water in it. The palladium sample was placed in a quartz glass cell with 100 g of heavy water electrolyte. It was surrounded by a platinum mesh, which served as the anode. Electrolysis was performed for three hours. Immediately after that the palladium cathode was transferred to a light water cell, where light hydrogen absorption was performed. At this stage voltage was 10 V, and current was about 2 A. The light water cell was made of Pyrex, 10 cm diameter, 20 cm high, with a silicon rubber lid. The palladium was introduced through a hole in the lid. The cell was also equipped with a platinum mesh anode in a configuration similar to the heavy water cell. In this phase, voltage was 40 V, and current reached a maximum of eight amps, but because the electrolyte temperature rose rapidly toward boiling, current was reduced to 1 A.

Neutrons were measured with three external He^3 detectors placed above the cell. The detectors were calibrated with a standard Cf^{292} neutron source (2.58×10^4 decay/s). To reduce noise, the detector was covered by electromagnetic shielding. After calibration, neutrons and noise were distinguished by covering one of the detectors with a 0.5 mm thick Cd film. The background count was 0.008 ± 0.003 c/s.

The experiment was performed ten times. A particularly striking example is shown below. Figure 1 shows the neutron counting rate, and Figure 3 shows the voltage, current, and electrolyte temperature during the same run. In this example, voltage was raised to 85 V at 3000 s, and immediately after that a burst of neutrons was observed. As shown in Figure 1, 25,800 neutrons were observed emitted from the cathode, with the counting rate of 1 c/s. Neutron production peaked when voltage was raised, and 200 s after that fell to the background levels again. During this period the total neutron count was 1.3×10^6.

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$$c_{(\vartheta)} = \frac{c}{1+\beta\cos\vartheta} \tag{6}$$

Of course, from (6) we obtain a velocity on closed paths equal to c in every inertial frame.

Equation (6) is particularly important to us: c one-way depends on the absolute velocity of the system (with respect to S_0) and that therefore it is different, on the Earth in motion, in different moments of synchronization between the stations.

But then, if the signals of synchronization travel at different speeds, one should detect an out-of-phase effect between the clocks.

If there weren't any other effects, this would be true. But from the Inertial Transformations we can deduce that there must also be *another reason* for an out-of-phase effect between the clocks.

5. Application of the Inertial Transformations to the Rotating Earth

The two synchronization signals of Figure 1 propagate, in S, respectively, at:

$$c_1 = \frac{c}{1+\beta\cos\vartheta_1} \quad \text{and} \quad c_2 = \frac{c}{1+\beta\cos\vartheta_2} \tag{7}$$

while the arrival station moves away at the rotation velocity. But S (which synchronized its clocks according to the Inertial Transformations) does not detect a uniform rotation velocity. Let us explain why.

We set in S a segment P-Q with a unitary length, and when the terrestrial station A (at velocity u_A) passes close to P, P itself sends out a light signal (at c_A velocity). In Q we measure the time lag between the arrival of the light signal and the passage, still in Q, of the station A.

This delay will be the difference between the propagation times: $1/u_A - 1/c_A$. This measurement is made with one clock only, so the result cannot depend on the synchronization used and must be the same that would be obtained according to SR. Therefore, this delay does not depend on the position or the direction of the velocities used in the measurements.

So, u_1 and u_2 being the two velocities of Earth on two generic positions 1 and 2, the time differences must be equal:

$$\frac{1}{u_1} - \frac{1}{c_1} = \frac{1}{u_2} - \frac{1}{c_2} \tag{8}$$

c_1 being different from c_2, u_1 will also be different from u_2, as is immediately clear from (8). Substituting (7) in (8), one easily gets:

$$\frac{c-\beta u_1\cos\vartheta_1}{u_1} = \frac{c-\beta u_2\cos\vartheta_2}{u_2} \tag{9}$$

a result which will soon be useful.

Let us apply what we obtained above to the physical context.

According to (5), if u_1 and u_2 are the rotation velocities of the stations (measured in S) in the two cases, the corresponding absolute velocities v_1 and v_2 will be:

$$v_1 = \sqrt{\left(v+\frac{u_1\cos\vartheta_1}{\gamma^2}\right)^2 + \left(\frac{u_1\,\mathrm{sen}\,\vartheta_1}{\gamma}\right)^2}$$

$$v_2 = \sqrt{\left(v+\frac{u_2\cos\vartheta_2}{\gamma^2}\right)^2 + \left(\frac{u_2\,\mathrm{sen}\,\vartheta_2}{\gamma}\right)^2} \tag{10}$$

A short direct calculation of γ_1^{-2} and γ_2^{-2} starting from (4) and (10) gives

$$\begin{cases} \gamma_1^{-2} = \dfrac{1-\beta^2}{c^2}\left[(c-\beta u_1\cos\vartheta_1)^2 - u_1^2\right] \\ \gamma_2^{-2} = \dfrac{1-\beta^2}{c^2}\left[(c-\beta u_2\cos\vartheta_2)^2 - u_2^2\right] \end{cases} \tag{11}$$

whence, taking (9) into account:

$$\gamma_1^{-2} = \frac{u_1^2}{u_2^2}\gamma_2^{-2} \tag{12}$$

Therefore:

$$\gamma_1 u_1 = \gamma_2 u_2 \tag{13}$$

The condition (13) allows us to reason as follows.

The contractions of bodies in motion are due to the *absolute* velocities and these velocities, in the considered cases of Figure 1, are different: in the first case rotation contributes to an increase of v_1, while in the second case it contributes to a decrease of v_2 (in the whole upper hemisphere of the picture the absolute velocities are larger than in the lower hemisphere).

So the contractions are different and, being also real, they produce a dishomogeneity of the body itself (Figure 3): the distances among the atoms are smaller in position 1 (and in the whole upper hemisphere) than in position 2 (in the whole lower hemisphere). What has to be kept uniform is not the velocity of rotation but the "flow," the flux of matter, the number of atoms that traverse any given section in the unit of time. Equation (13) ensures exactly this.

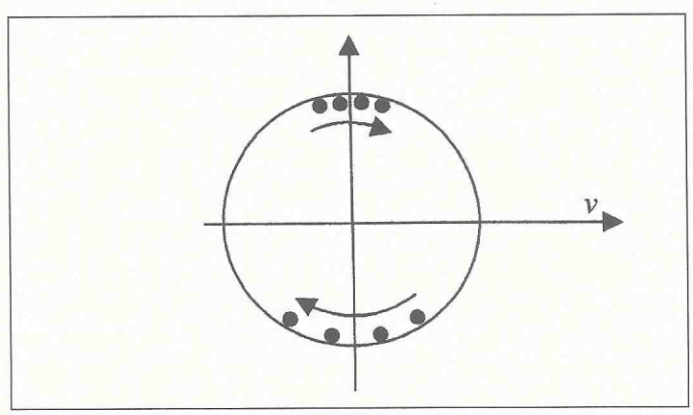

Figure 3. Dishomogeneity of a rotating and translating body.

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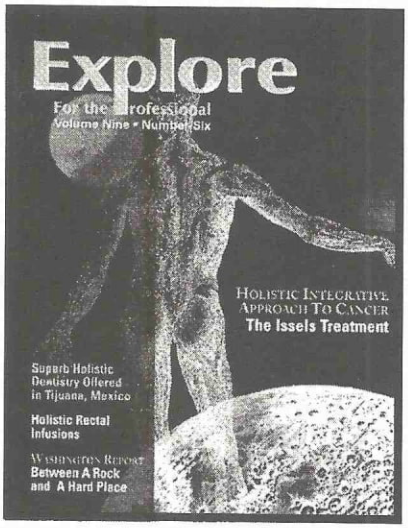

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correction must be applied. But, in the present case, the well-known Sagnac effect[9] has not been taken into account because in the situations here considered it contributes with *constant* and equal delays in every position of the stations. Since we have considered the *difference* between the delays in different positions, the Sagnac effect is irrelevant here.

7. Conclusions

- Galileo's Transformations do not explain the proper working of TAI.
- With Lorentz's Transformations c is isotropic in every inertial system and the clocks must always be synchronous. This is one way to explain these matters but it is not the only one.
- The proper working of TAI is also explained by Selleri's Inertial Transformations, which predicts that one-way light velocity is not isotropic in all inertial systems, but that it depends on the absolute velocity of the system itself.
- With the Inertial Transformations we have two out-of-phase effects on the clocks: the first one because of the c anisotropy, the other one because of the variations in the clocks' pace, due to their different absolute v. The two effects are equal and opposite and the clocks appear to be synchronized again. The signals of synchronization will always arrive "on time," *exactly as if the light always traveled at c velocity on the moving Earth.*
- The proper functioning of the International Atomic Time System only demonstrates Galileo's Transformations do not function, but it does not say anything about the isotropy of one-way speed of light in every inertial system.

I thank Prof. F. Selleri for the interesting discussions and the fruitful suggestions that he made to me. I'm very grateful to Prof. M.L. Bartolini for translation and support.

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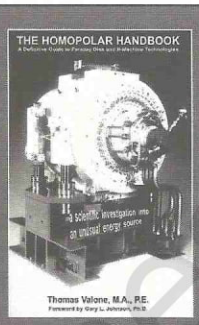

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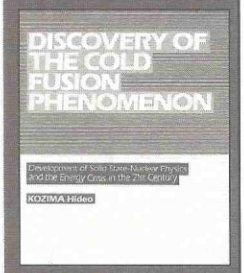

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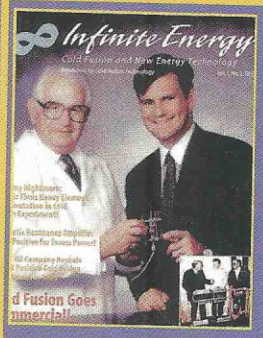

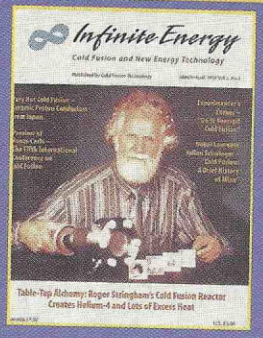

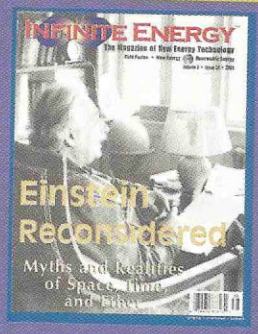

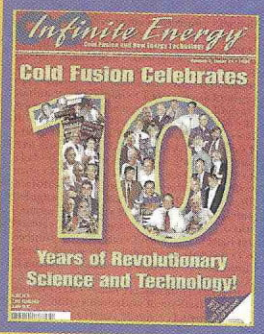

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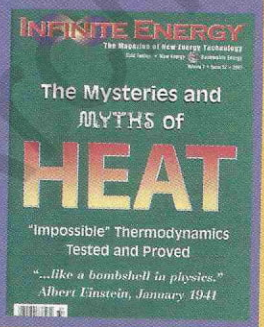

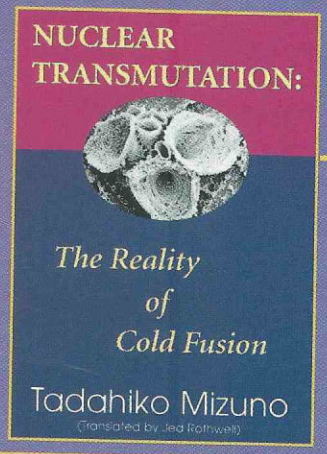

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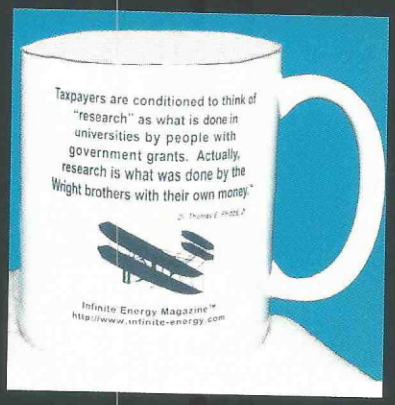

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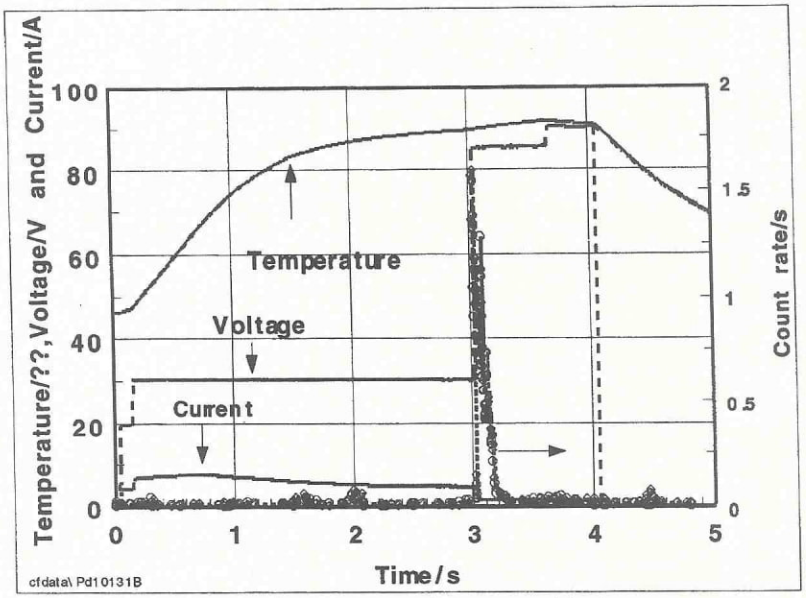

Figure 1. Neutron counts after absorbing deuterium and hydrogen.

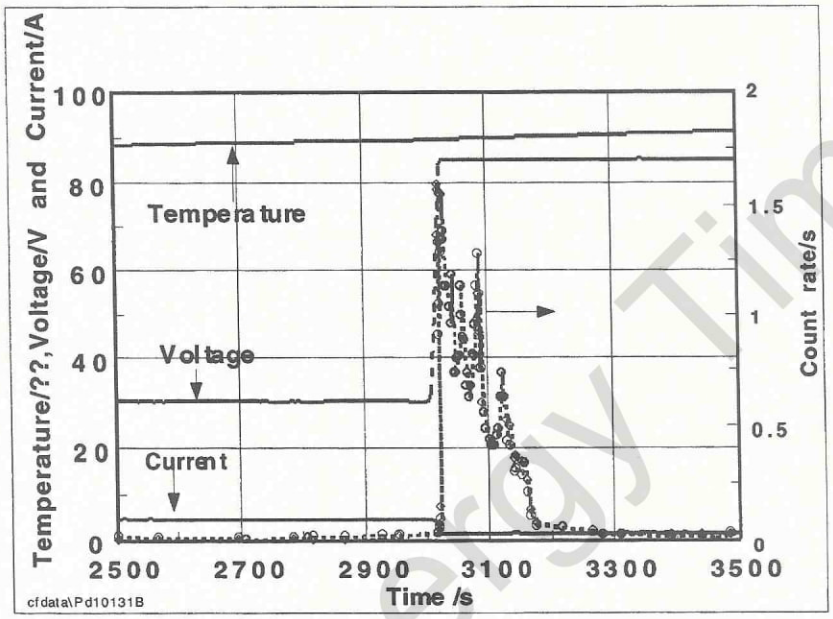

Figure 2. Results for 3000 s magnified. Electrochemical conditions during the tiime at 3000 s are shown too. After electrolysis voltage was raised to 80 v, neutron emissions suddenly occurred.

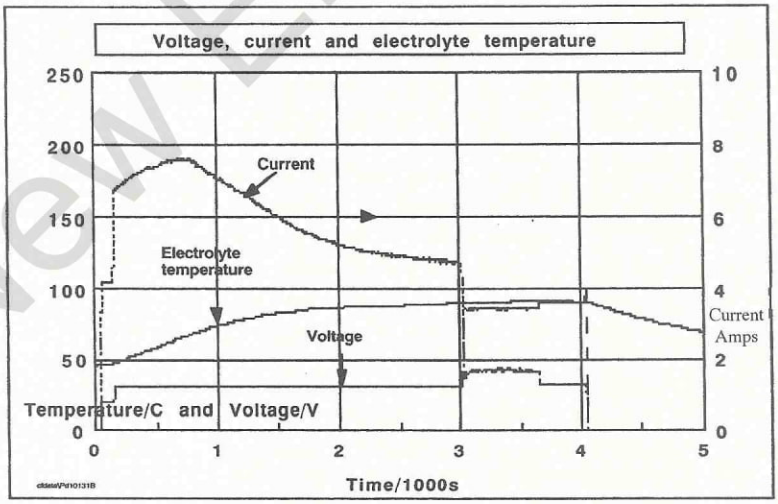

Figure 3. Voltage, current, and electrolyte temperature during the experiment shown in Figure 1. The electrolyte was 0.2 M K_2CO_3.

In this example, electrolysis in light water continued for a considerable time, and neutron emission was observed when voltage increased. However, in other runs neutron emission was observed immediately after light water electrolysis commenced. In these other examples, the total neutron count ranged from 10^5 to 10^6, and emissions generally lasted 10 ~ 200 s. All cases were marked by a characteristic high level of neutron emissions at first, which gradually declined.

Neutron emissions during light water absorption following heavy water absorption are very difficult to explain by the models proposed heretofore, which involve d-d fusion reactions. These other models assume that neutron emissions occur when heavy water alone is absorbed, and the emissions must be accompanied by excess heat and tritium production. The reaction we observed came about after alternating absorption of deuterium followed by protium, and the reaction appears to be highly reproducible, reliably generating high neutron emissions. We conclude that the models proposed heretofore based upon d-d reactions are inadequate to explain our present results, which must involve protium nuclear reactions.

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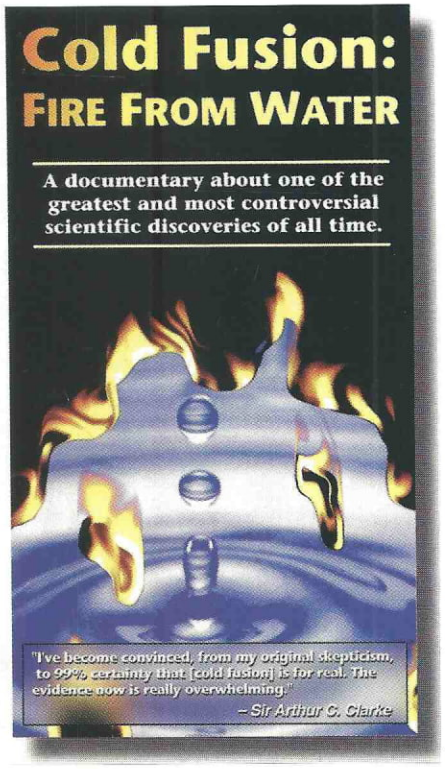
Cold Fusion:
Fire From Water



This informative documentary, produced in 1999, is narrated by James "Scotty" Doohan (of "Star Trek"). It features cold fusion scientists from around the world discussing cold fusion history and current research. Find out what has happened in the cold fusion field since the Utah announcement by Pons and Fleischmann in March 1989.

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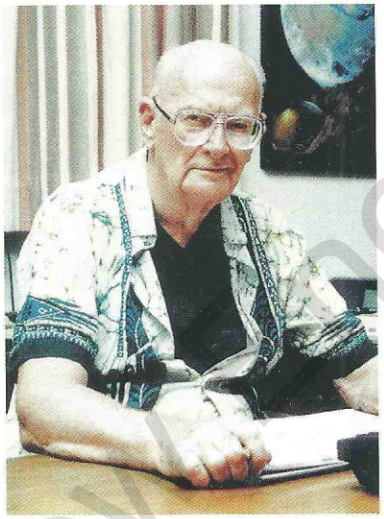

"It could be the end of the fossil fuel age: the end of oil and coal. And the end, incidentally, of many of our worries about global pollution and global warming."

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Narrator: James Doohan

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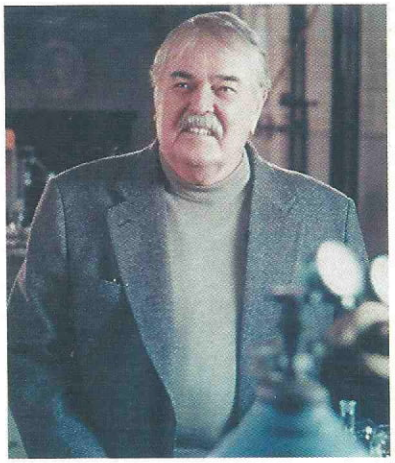

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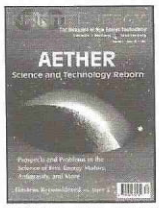

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